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Schafer, W. M
Golden Maple
Mining Company,
Gilt Edge Mine
site closure and
process solution
land application

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GOLDEN MAPLE MINING COMPANY
GILT EDGE MINE
SITE CLOSURE AND PROCESS SOLUTION LAND APPLICATION DESIGN

submitted to :

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1.0 BACKGROUND

1.1 LOCATION

The Golden Maple Mining and Leaching Company submitted a permit application on December 31, 1983 to open a heap leach gold mine near Giltedge, Montana in the north 1/2 of section 20, Township 16 North, Range 20 East (Figure 1). The site is northeast of Lewistown, Montana.

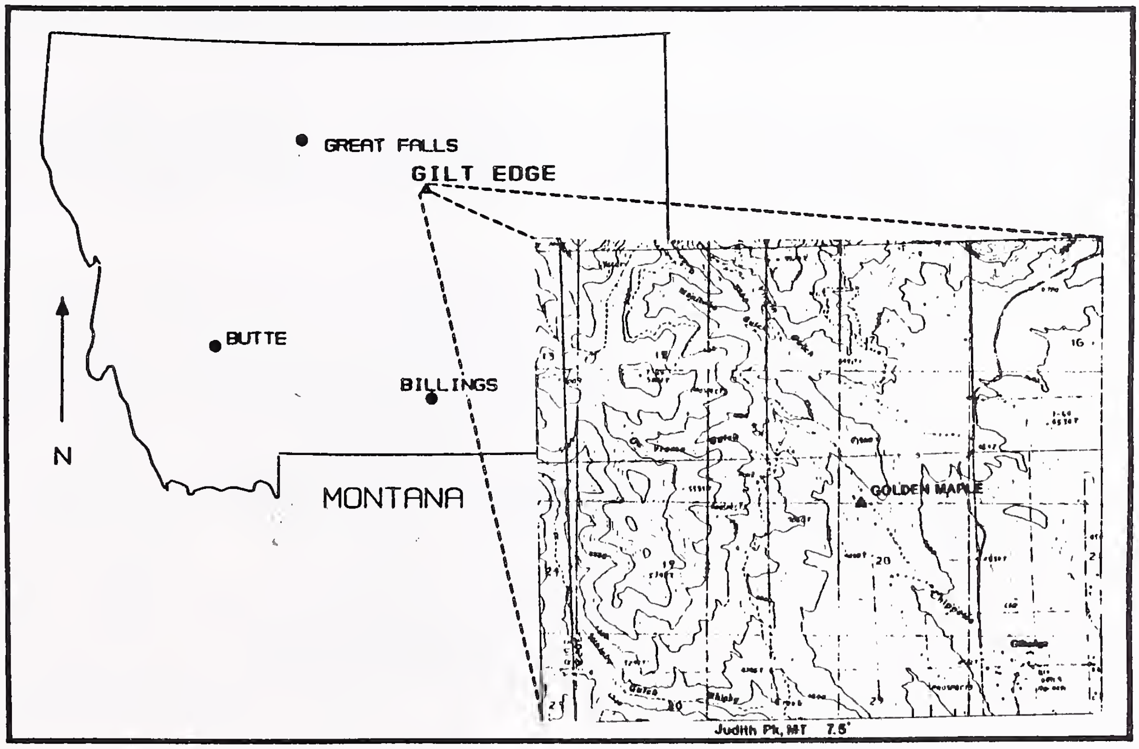

Figure 1. Location of the Golden Maple Mining Company Gilt Edge Mine near Lewistown, Montana.

1.2 Geologic Setting

The Gilt Edge Mine is situated in the Madison Limestone (Mississippian) which is overlain locally by the Big Snowy Group consisting of the Kibbey Sandstone, Otter Shale, and the Heath Formation. A 25 to 50 foot thick porphyritic rhyolite low-angle dike transects the Madison. Locally, basal mineralization has enriched gold content.

Ore loaded on the heap leach was obtained from the Old Jig Tailings in Ox Frame Gulch, from the previously existing Lookout and Cuba Pits, and from underground mining in Virgin Gulch in the

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Turtle Winze zone. The mining plan called for mining 100,000 tons per year of ore. The expected life of mine was 10 years.

The mine was located in a historic mining district. As a result, the baseline environmental conditions reflected serious degradation due to previous mining practices.

1.3 Permit Violations

The Gilt Edge Mine started leaching early in 1985 (Grotbo, 1985). By April, 1985 several permit violations had occured at the mine. These violations initiated a series of site visits and letters from the State of Montana regarding purposeful discharge of process solution, lack of diversion trenches, liner leaks, and substitution of liner material not specified in the permit application. Violations of the operating permit also resulted in complaints from local residents (Duffy, 1985).

Specific permit violations outlined in a memo dated 21 October 1985 from Terry Grotbo to Dennis Hemmer and a memo dated 8 November 1985 from Chuck Baltzer to Terry Grotbo are outlined below:

* 4/2/85 continuous discharge - breach in pond
* 4/4-13/85 purposeful discharge - 77,760 gallons
* 4/7/85 purposeful discharge
* 4/10-11/85 purposeful discharge - 180 gallons
* 4/29 tear in liner noted
* no monthly water quality tests submitted
* no daily presumptive cyanide tests submitted
* no surface diversion ditch installed as shown in permit application.
* PVC liner substituted for Hypalon
* no interdiversion structure
* surface and ground water (spring) data indicated cyanide contamination.

As a result of the repeated violations and lack of progress in obtaining compliance with the permit application, a notice of non-compliance and order of suspension was sent to the Golden Maple Mining Company on August 1, 1985 (Hemmer, 1985).

Golden Maple continued to try to clean up the damage created by installing the required ditch, creating a new emergency pond (to replace the one they had converted to a process pond) and to treat and discharge excess process solution. Field notes collected by Chuck Baltzer in mid-October 1985 indicated that process solution was being discharged below the new emergency pond and found its way into Chippewa Creek. Heavy precipitation received on the site during August and September reduced the freeboard in the ponds to a critical degree.

Due to the inability of the Golden Maple Mining Company to

continue the reclamation process and the lack of liability coverage from the insurer of the property, the State decided to use the performance bond for site closure activities.

A number of on-site field experiments were conducted to design the proposed treatment methods for site closure. In addition, a series of monitoring wells were installed to estimate the impact of the cyanide process solution release on surface and ground water quality.

1.4 Environmental Impacts

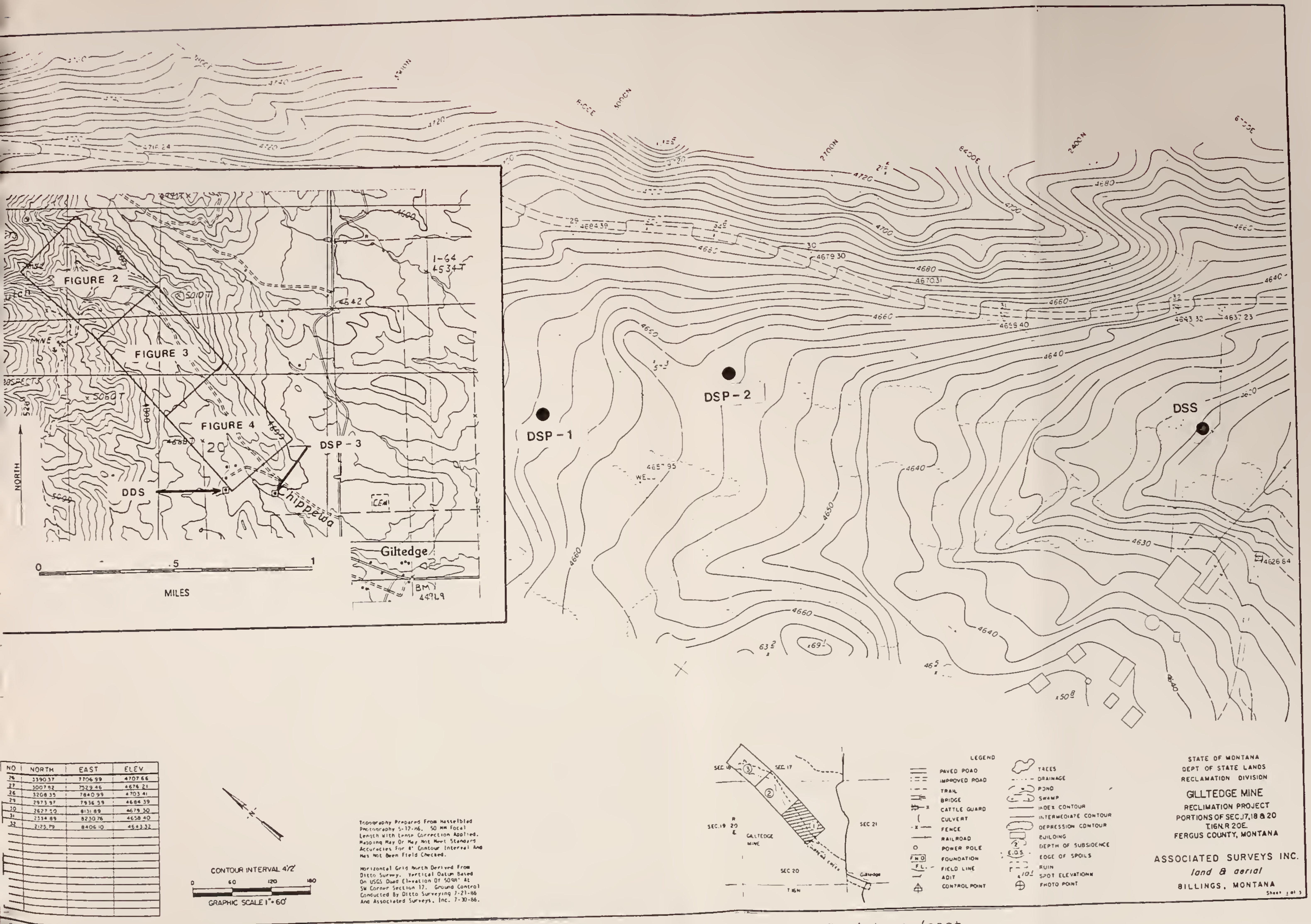
A number of surface and ground water stations were sampled periodically beginning during Golden Maple operation, and continuing through closure activities. Monitoring is still ongoing as of the publication date.

A number of grab samples of surface water were collected of runoff at various locations and of water samples from Chippewa Creek and from small ephemeral drainages. A list of the drinking water quality exceedences is shown in Table 1. All surface water data are attached in Appendix C.

Table 1. Surface water locations and drinking water exceedences for data from the Golden Maple mine site.

SAMPLING STATION	DATE	PARAMETERS EXCEEDED (mg/l) *
Chippewa Creek		none
Diversion Ditch	3/28/86	HCN=30.0, As=2.4, Hg=1.13
Emergency Pond discharge	5/12/86	HCN=11.3, As=0.057, Hg=0.003
Golden Maple Creek	5/1/87	HCN=0.01, As=0.02
North Hill runoff	10/30/85	HCN=40.0
Ore heap discharge	5/28/86	HCN=15.2, As=0.10, Hg=0.002
Ponded water above reclamation	4/7/87	HCN=0.019, As=0.396
SW2		none
SW3		none
Triad SW1, downstream below old tailings	12/16/86	HCN=0.013, As=0.042
Upper tailings runoff	4/7/87	HCN=0.038, As=1.75, Cd=0.016

* water quality standards from Davis and DeWiest (1966).



NO	NORTH	EAST	ELEV
26	3390 37	7706 99	4707 66
27	3007 92	7529 46	4676 21
26	3208 35	7840 99	4703 41
29	2973 97	7936 59	4684 39
30	2627 50	8131 89	4679 30
31	2334 89	8230 76	4658 40
32	2125.79	8406 10	4643.32

Topography Prepared From Hasselblad Photography 5-17-86. 50 MM Focal Length With Lense Correction Applied. Mapping May Or May Not Meet Standard Accuracies For 4' Contour Interval And Has Not Been Field Checked.

Horizontal Grid North Derived From Ditto Survey. Vertical Datum Based On USGS Quad Elevation Of 5099' At SW Corner Section 17. Ground Control Conducted By Ditto Surveying 7-21-86 And Associated Surveys, Inc. 7-30-86.

Figure 4. Location of the Golden Maple mine near Lewistown (east section).

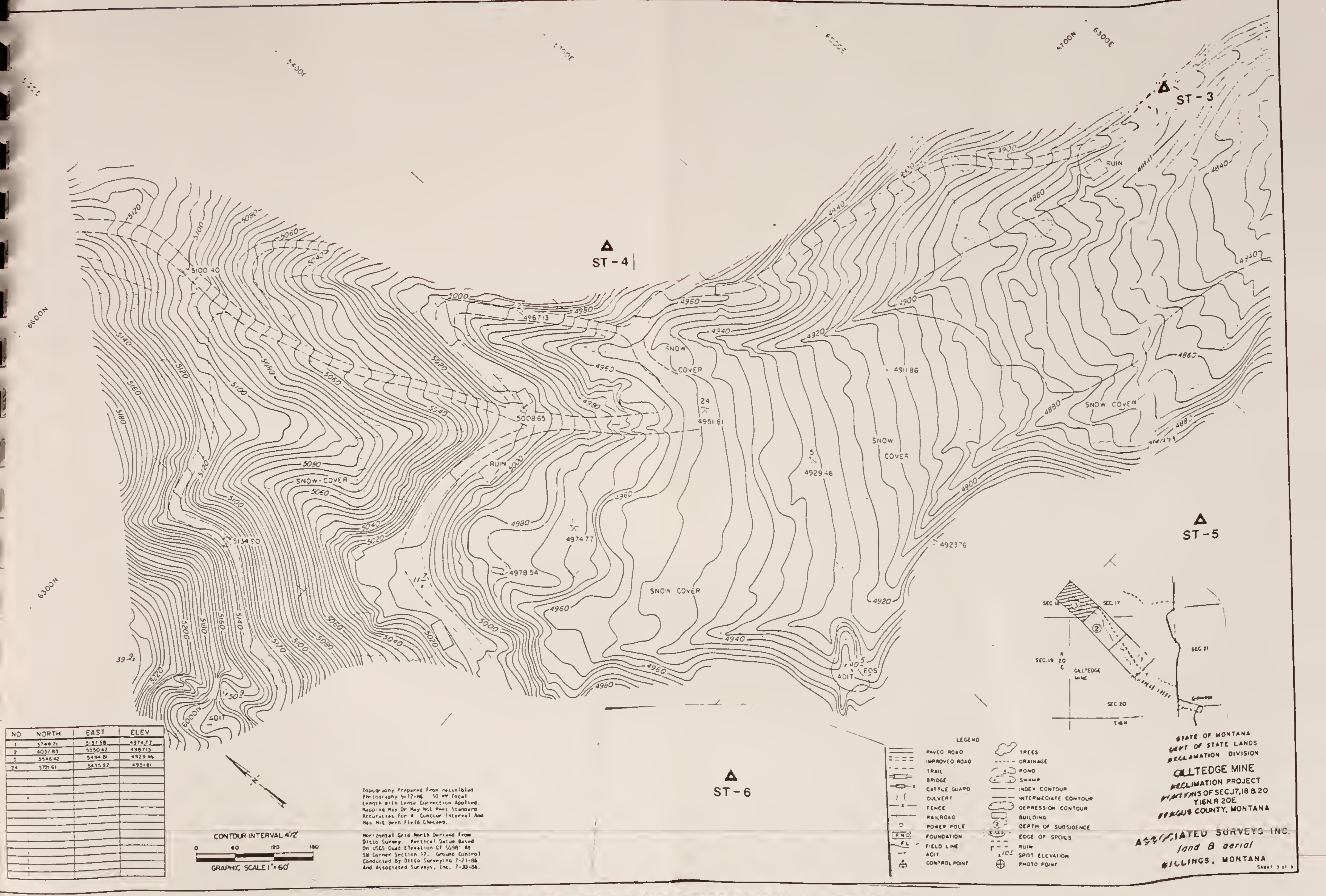
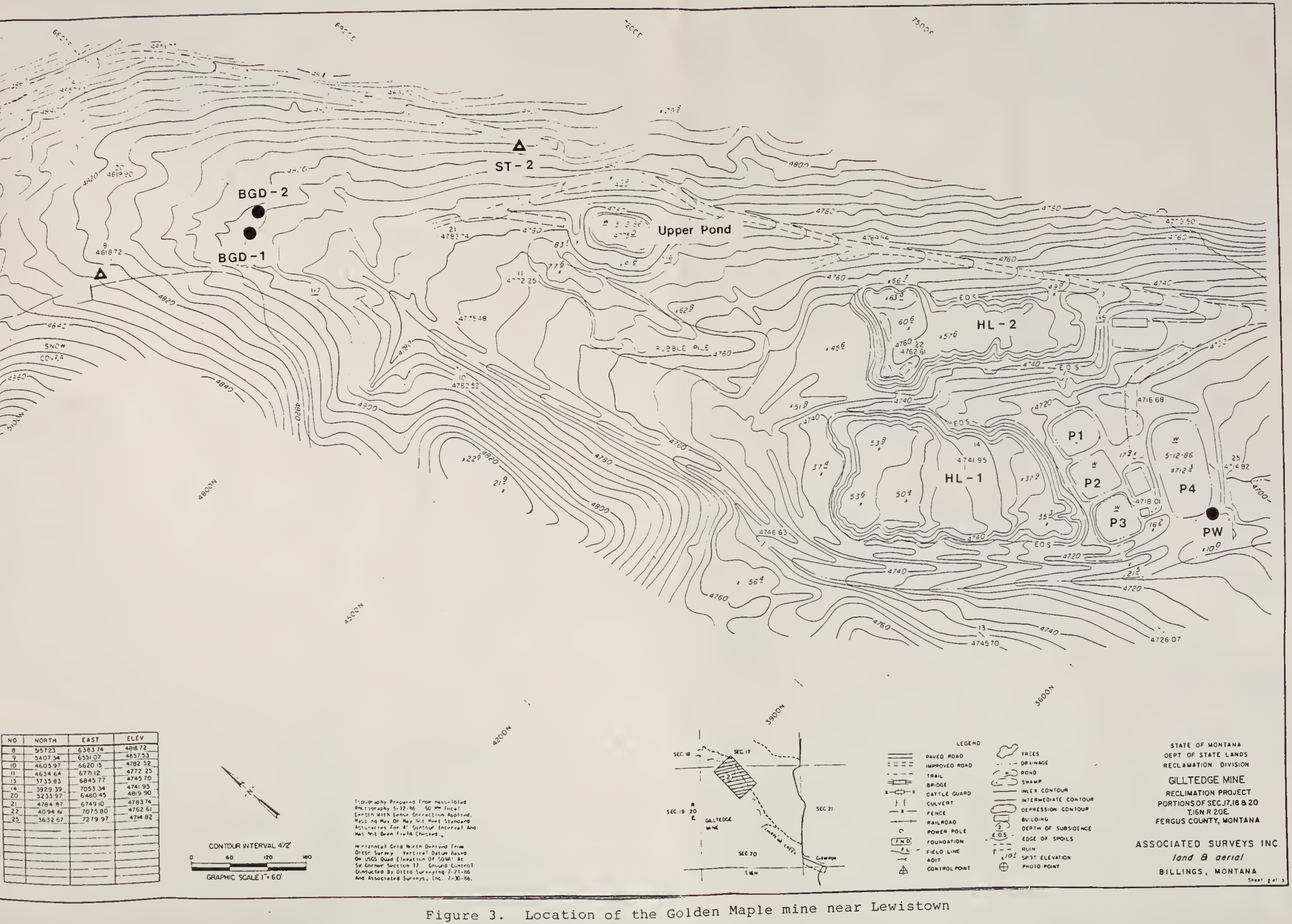


Figure 2. Location of the Golden Maple mine near Lewistown (west section).



NO	NORTH	EAST	ELEV
8	5157 23	6383 74	4818.72
9	5407 34	6551 07	4857 53
10	4605 97	6620 15	4782 52
11	4634 64	6771 12	4772 25
13	3735 83	6845 77	4745 70
14	3929 39	7053 34	4741 95
20	5233.97	6480 45	4819 90
21	4784 87	6749 10	4783 74
22	4094 61	7075 80	4762 61
25	3632 67	7279 97	4714 82

Topography Prepared From Hasselblad Photography 5-12-86 50 mm Focal Length With Lense Correction Applied. Mapping May Or May Not Meet Standard Accuracies For 4' Contour Interval And Has Not Been Field Checked.

Horizontal Grid North Derived From Ditto Survey. Vertical Datum Based On USGS Quad Elevation Of 5098' At SW Corner Section 17. Ground Control Conducted By Ditto Surveying 7-21-86 And Associated Surveys, Inc. 7-30-86.

Figure 3. Location of the Golden Maple mine near Lewistown (center section).

A number of locations exceeded recommended drinking water standards for cyanide, arsenic, mercury, and cadmium. Samples from downstream of the site were generally within acceptable limits for all parameters.

A number of local wells were sampled during the site closure. Ground water monitoring stations included a stock well and domestic well at the Duffy's residence (developed springs), the mines production well located just below the new emergency pond, a background well located just up-gradient of the mine, and three new wells (DSP-1, DSP-2, DSP-3). Well completion forms are included in Appendix E.

Well locations are shown in Figures 2 through 4. Plots of total and chloride amenable cyanide for each well sampled are shown in Figures 5 through 11. Other data collected are presented in Appendix B. Cyanide levels in the Duffy's stock and domestic wells were at or slightly above the recommended level 0.01 mg/l through August of 1985. Samples from after that date increased dramatically to roughly 0.05 mg/l in the domestic well to 0.12 mg/l in the stock well. Samples collected in May, 1987 showed an apparent decline to 0.02 and 0.10 mg/l respectively. Data collected seem to indicate a seasonal decline in cyanide to a minimum in early spring perhaps during spring runoff. Late winter concentrations appear to reach maximum annual levels. This trend may indicate dilution of the cyanide by heavy recharge of the shallow alluvial aquifer along the Creek induced by runoff. Higher concentrations during base-flow may suggest a localized input of cyanide into the alluvial aquifer. These trends would indicate that the Golden Maple operation or old tailings above the mine would account for the cyanide. The timing of the increase in cyanide concentration after known releases from the mine further strengthen the case for pollution stemming from the Golden Maple operation.

Data from the Production Well indicate very high cyanide levels beginning in June, 1985 (>1.3 mg/l) and continuing at levels to 0.6 mg/l through May, 1987. Well DSP-2 shows significant increases in cyanide above background (assumed to be below detection). The background well and DSP-1 and DSP-3 are all at or near detection and do not indicate as severe a level of contamination. Cloride amenable cyanide was mostly at or near the detection limit (0.005 mg/l) except for December 1985 in Duffy's domestic well and all dates in the Stock well and May, 1985 for the production well.

Data for trace metals are not available for many dates and hence are not plotted. Most metals were below detection limits or below drinking water standards. Arsenic exceeded suggested concentrations in the Background well (0.043 mg/l), in DSP-2 (0.013 mg/l), and in the Stock well (0.013, 0.023 mg/l).

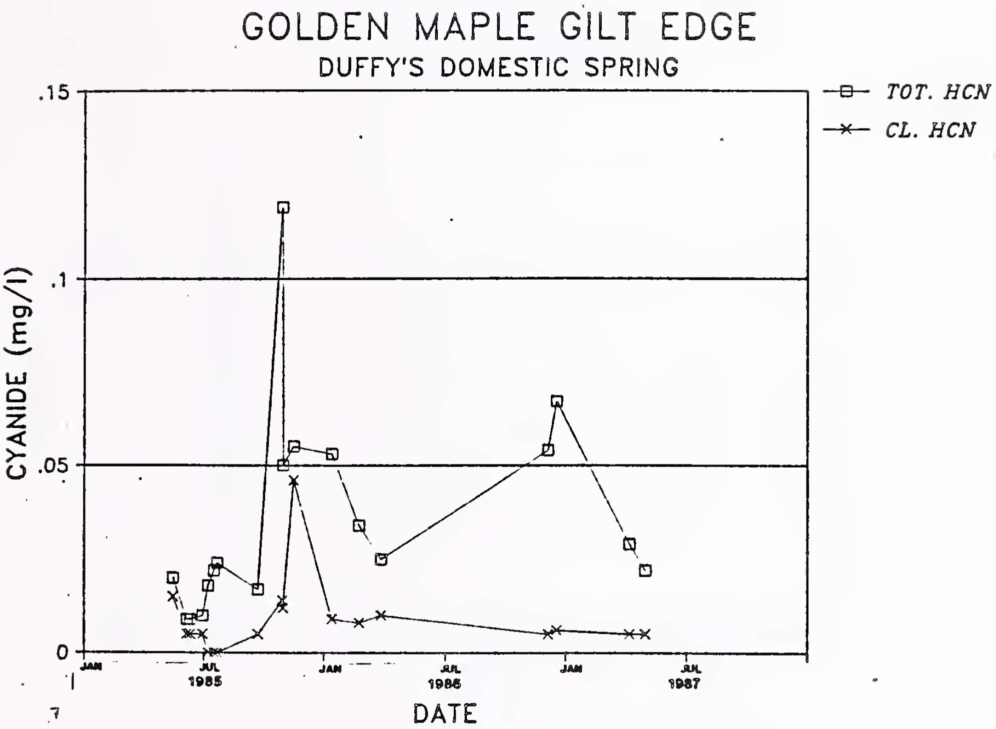


Figure 5. Total and chloride amenable cyanide in Duffy's domestic spring.

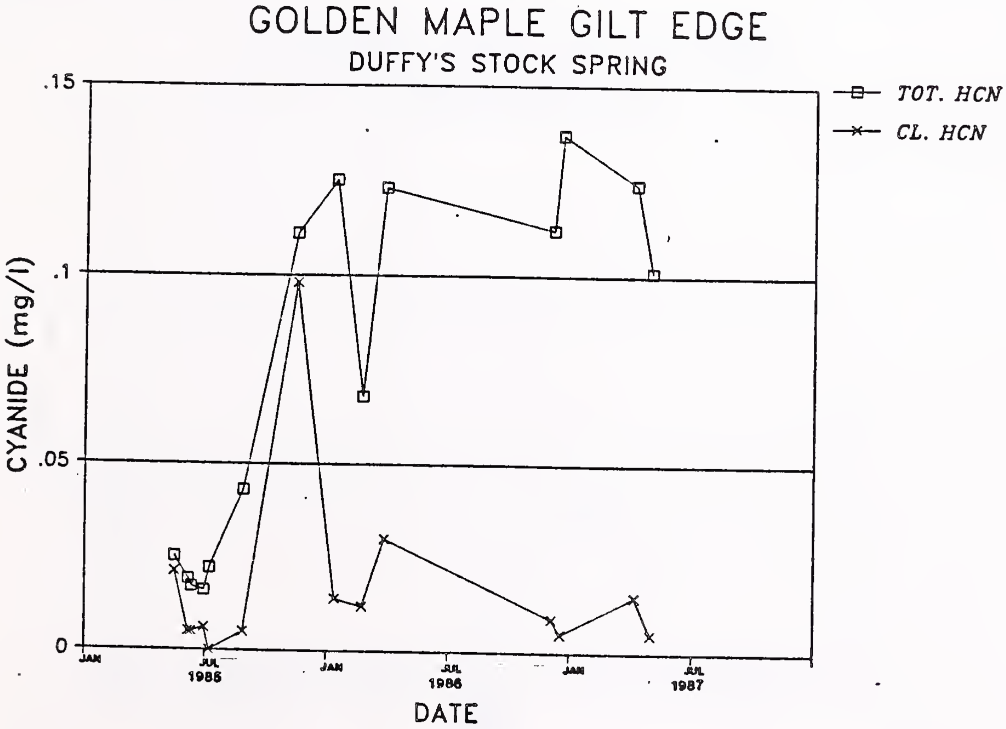


Figure 6. Total and chloride amenable cyanide in Duffy's stock spring.

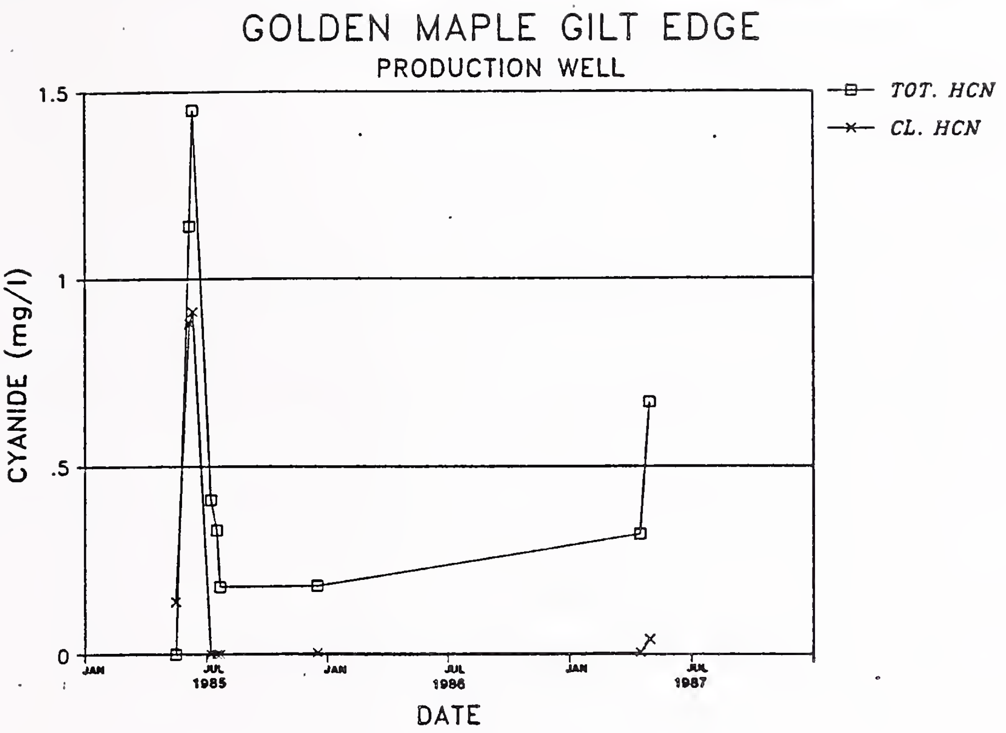


Figure 7. Total and chloride amenable cyanide in the Golden Maple production well.

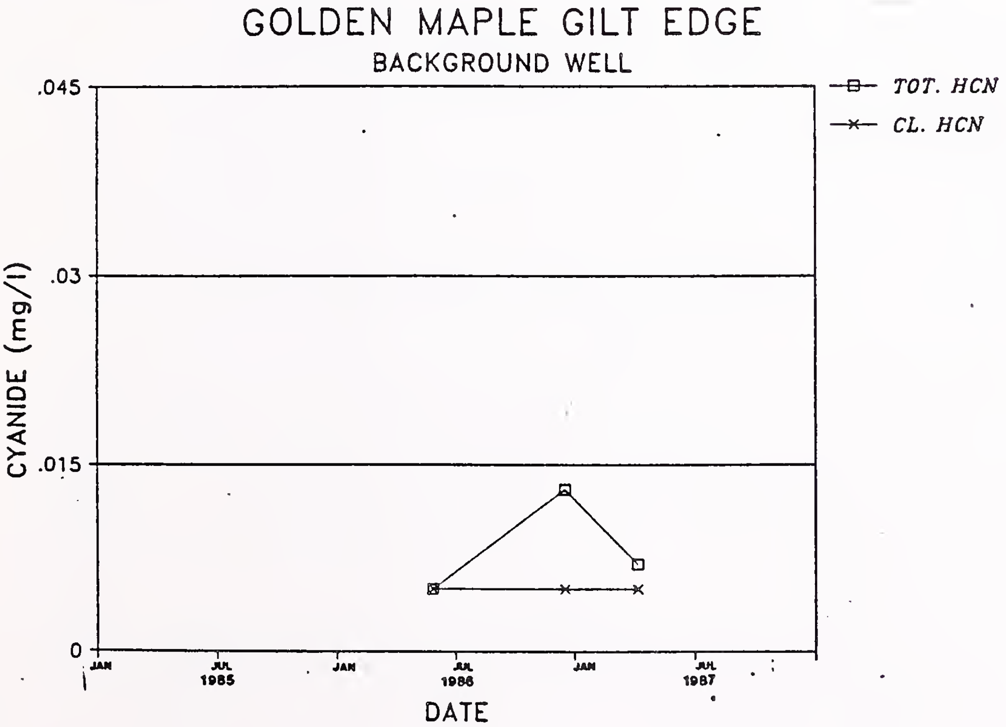


Figure 8. Total and chloride amenable cyanide in the Golden Maple background well.

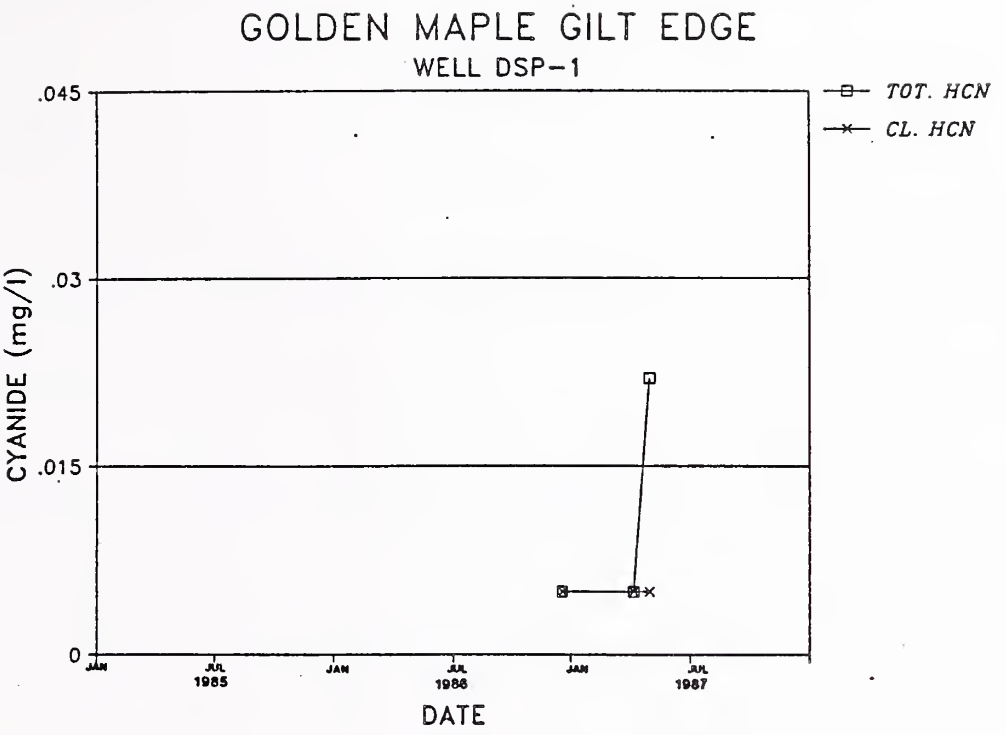


Figure 9. Total and chloride amenable cyanide in the Golden Maple well DSP-1.

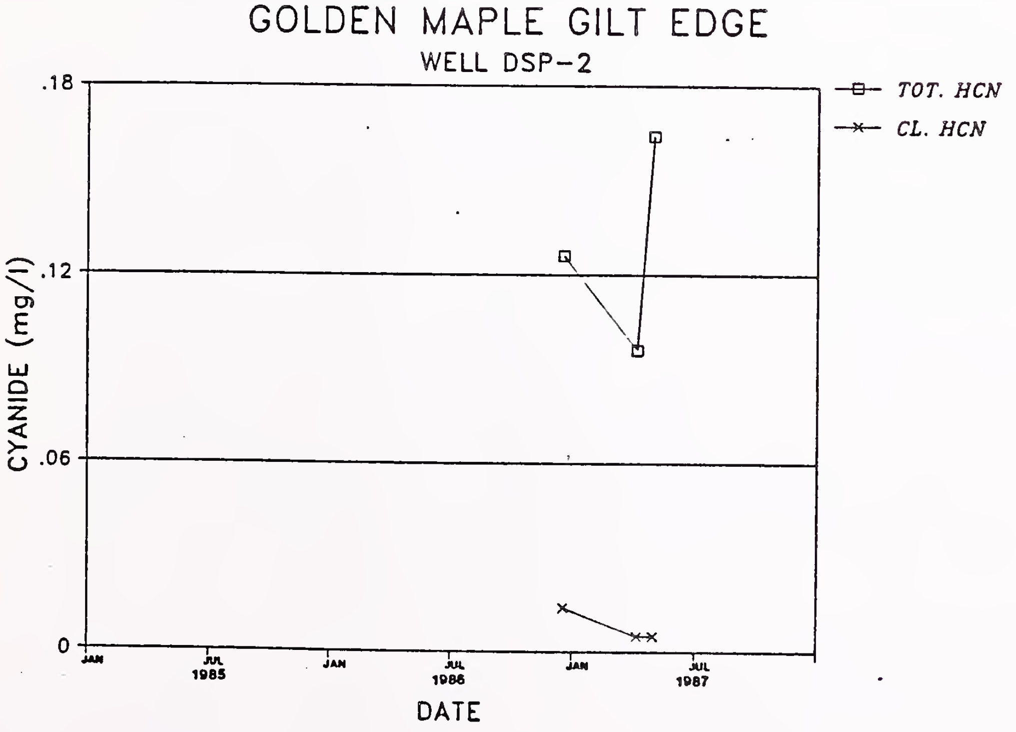


Figure 10. Total and chloride amenable cyanide in the Golden Maple well DSP-2.

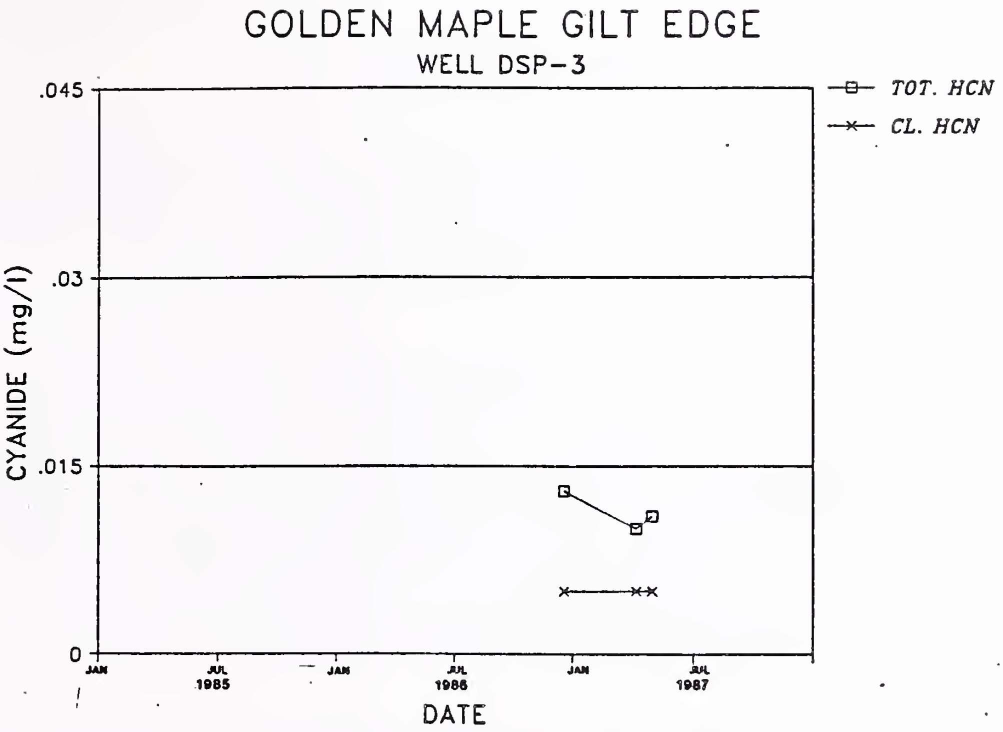


Figure 11. Total and chloride amenable cyanide in the Golden Maple well DSP-3.

2.0 REMEDIAL DESIGN

The conceptual site closure plan was to treat cyanide and metal-bearing process solution and to land-apply the treated solution on-site. Liners and pond sediments would then be encapsulated in the existing ponds.

2.1 Fate of Cyanide and Trace Metals

In order to properly design a closure program for a site with cyanide and trace metal-bearing process solution, an understanding of the potential fate and transport of these constituents is required. While the effects of cyanide and metals on aquatic organisms in surface water is relatively well understood, the movement of these contaminants in surface soils and effects on soil microorganisms and higher plants is less well understood.

Cyanide forms a wide variety of complexes with a number of metals. Its extreme reactivity in natural systems is the basis of its utility in the mining industry and its potential adverse effects in the environment. Due to the complexity of cyanide reactions, several analytical techniques to assess the various forms of cyanide have been developed.

The four most common cyanide analyses include total, cloride amenable (CA), weak-acid dissociable (WAD), and free cyanide (Huiatt at al. 1982). Total HCN is usually analyzed by reflux acid distillation. Total HCN analysis includes CN ion, HCN, weak-acid dissociable CN, complexed iron-cyanide, and other metal complexes except those of Au, Co, and Pt. Total HCN analysis is subject to interference from thiocyanate, a common product of cyanide oxidation. Chloride amenable HCN is measured by running total HCN before and after a chloride oxidation treatment. The chloride oxidation removes free cyanide, and all complexes except those of Co, Fe, Pt, and Au. This method is also subject to thiocyanate interference. The weak-acid dissociable cyanide method involves an acetate (pH 4.5) extraction of CN, HCN and complexed Cd, Cu, Ni, and Zn cyanide complexes. The WAD method is not subject to thiocyanate interference. Free cyanide is a measure of CN ion, and HCN in solution.

Free cyanide is very toxic to aquatic and terrestrial organisms and is very mobile in soils. Attenuation of free cyanide in soils is a function of soil pH, Fe(OH)3 content, clay mineralogy, free CaCO3 and clay content. High pH, presence of free lime, low clay content, or smectite clay type tend to favor cyanide mobility (Alesii and Fuller 1976). Cyanide ions are not

strongly adsorbed in soils (Murrman and Kuotz 1972). Cyanide tends to react quickly in soil to form simple ion salts which then biodegrade to nitrate and carbon dioxide, or form insoluble metal complexes (USEPA 1976).

Free cyanide reacts readily with sulfur to form thiocyanate (SCN), forms metal complexes, volatalizes, is metaboloized by microorganisms, hydrolizes to ammonium and formate, oxidizes to cyanate than degrades, or can be bound to organic matter (Towill et al. 1978). Many reviewers have concluded that free cyanide will not move significantly in soil or have a long residence time except in the case of gross pollution (Schmidt 1981, Ecological Analysts 1979). Dissolved HCN has a high vapor pressure and can volatalize from a free water surface rather rapidly (Chester Engineers 1977). Bacteria, fungi, and algae have been shown to metabolize cyanide (Huiatt et al. 1983) as have higher plants, animals, and man. Cyanide can be oxidized chemically to CNO by ozone or ultraviolet light (Owenbach 1978). Ferrocyanide may degrade to liberate free cyanide photochemically, a potential concern where a free water surface of cyanide-bearing solutions exists.

Free cyanide is very toxic in freshwater systems. The LD50 for free cyanide ranges from 0.03 mg/l for Rainbow Trout to 0.13 mg/l for more tolerant fishes (Huaitt et al. 1982). Sublethal effects on reproduction have been noted at concentrations as low as 0.01 mg/l. In humans, lethal cyanide doses range from 80 to 200 mg/kg of body weight. A concentration of 100 mg/kg body weight is lethal if cyanide is adsorbed dermally.

In soils, cyanide is less lethal than in aquatic systems. This may be due in part to its limited persistence as free cyanide. Cyanide at levels of 50-100 mg/kg in soil has been shown to be toxic to plants (Wallace et al. 1977). In adddition, trace metal uptake was increased at high cyanide levels. Many plants form cyanide naturally. Shroder (1977) found Coastal Bermudagrass with concentrations of up to 800 mg/kg on a fresh weight basis. Tobacco smoke is known to have high cyanide concentration though smokers do not appear to bioaccumulate cyanide. Plants along Whitewood Creek (Noble and Howe 1983) in South Dakota polluted by mining waste had elevated cyanide levels which were correlated with soil cyanide levels. Maximum cyanide levels in soil and plants were 16.2 and 137 mg/kg respectively.

Cyanide reacts with 28 metals to form 72 possible complexes varying in stability from very stable (CoCN, and ferro-cyanides) to very soluble (Cd(CN)4-2) (Huiatt et al. 1982). Typical flotation tailings are quite low in total cyanide due to the formation of insoluble ferrocyanide. Solid phase cyanide complexes have been shown to go through slow changes in solid phase composition to form less soluble complexes (Walker and Watkins 1968).

Cyanide complexes are relatively insoluble, however little

information is available on mobility of complexes in soil. While reviewers suggest that stable ferro-cyanide complexes are unlikely to migrate in soil (Huiatt et al. 1983), less soluble complexes may interact with soil adsorption sites.

An abundance of data are available on reactions of trace metals in soils and their potential for migration. A complete discussion on this topic is beyond the scope of this review. Iron, manganese, zinc, and copper exist as cations in soil environments. These elements are essential for plant growth and have been studied extensively. Manganese, copper, and zinc can also be phytotoxic at high concentrations in the soil solution. The potential for phytotoxicity from these elements is determined by their mineral form and not strictly by their total concentration. Factors such as low pH, low redox potential, gross mining waste pollution, and low organic matter or clay content tend to favor phytotoxicity. Cadmium, lead, and nickel are similar to copper and zinc in soil but are not essential for plant growth. The relative solubility of these elements in typical Western forest soils decreases in the general order Cd > Zn > Cu, Mn > Pb. Arsenic is defined as a metalloid and exists as an anion in soil environments. It exists predominantly in two valance states in moderately oxidized systems (+3 and +5). The +3 form (arsenite) is more mobile than +5 (arsenate). Arsenate behaves similar to phosphate in soil. Mercury forms strong bonds with soil organic matter and can volatilize under certain conditions.

2.2 Treatment of Process Solution

A variety of treatment techniques have been used for destruction of cyanides in process solutions. Methods are summarized in Table 2. Of these methods, the alkaline chlorination technique is the most commonly used. It is the best-suited method for remote sites because of its low cost, minimal capital requirements for processing facilities, its ease of application, and the flocculation of trace metals achieved. A summary of the effectiveness of a number of treatment methods is contained in Table 3 (Huiatt et al. 1983).

An alkaline chlorination treatment was used for neutralization of CN- in the process solution. Calcium hypochlorite ($Ca(OCl)2$) was the reagent used to minimize sodium concentration and to decrease the SAR in the final solution. The chlorination process is as follows:

FIRST STAGE:

$$2CN^{-} + Ca(OCL)_2 + 2H_2O = 2CNCl + Ca^{+2} + 4OH^{-}$$

$$2CNCl + 2Ca(OH)_2 = Ca(CNO)_2 + CaCl_2 + 2H_2O$$

SECOND STAGE:

$$Ca(CNO)_2 + 3Cl_2 + 4H_2O = 3Cl_2 + (NH_4)_2CO_3 + CaCO_3$$

$$(NH_4)_2CO_3 + 3Cl_2 + 3Ca(OH)_2 + CaCO_3 = Ca(HCO_3)_2 + N_2 + 3CaCl_2 + 6H_2O$$

The kinetics of this process require that the pH remain at 11 or higher for 10 minutes during the first stage and pH is then lowered to 8.5 for 30 minutes. For the second stage, pH should remain near 8.5 for 120 minutes or more. The use of Ca(OCl)2 requires 1 mole (142.9 g) of Ca(OCl)2 and two moles (148.2 g) of Ca(OH)2 for every mole (26 g)of CN to be treated. Solution pH should be maintained at a pH of 8.5 or above at all times during treatment to prevent volatilization. After addition of reagents, the process ponds should be circulated for at least 2 hours before sampling for residual CN^-.

Table 2. Processes for removal of cyanides from water.

- Natural degradation (lagooning)
    - dilution
    - volatilization
    - biodegradation
    - oxidation
    - metals precipitation
- Oxidation processes
    - alkaline chlorination
        - chlorine gas
        - hypochlorites
        - electrolytic generation
    - ozonation
    - hydrogen peroxide
    - INCO (sulfur dioxide + air)
- Acidification / volatilization / reneutralization
- Absorption Processes
    - ion exchange
    - activated carbon
    - ion flotation
    - precipitation flotation
- Electrolytic processes
    - cyanide regeneration
    - cyanide destruction
- Conversion to less toxic forms
    - thiocyanate
    - ferrocyanide
- Biological treatment

Table 3. Efficiency of several cyanide treatment methods for removal of cyanide and metals (Huiatt et al. 1983).

RESULTS FROM HOMESTAKE MINING COMPANY PILOT PLANT INVESTIGATIONS[1]

		OZONE		ACIDIFICATION VOLATILIZATION pH 4;4 hrs		ALKALINE CHLORINATION pH 4 4 hrs		ION EXCHANGE A-101-D		PRUSSIAN BLUE PPT		BIODEGRADATION	
		Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction
Total CN	Inf	0.21	33	25	60	10.77	99.5	27	30	7.83	91	5.5	95
	Eff	0.14		10		0.05		19		0.67		0.30	
Free CN	Inf	0.08	62.5	12	98	9.55	99	--	--	5.48	93	3.8	96
	Eff	0.03		0.18		0.02		--		0.37		0.16	
SCN	Inf	3.8	74	--	--	80	99	138	--	89	1	126	92
	Eff	1.0		--		NF		140		88		10	
Cu	Inf	0.03	17	3.4	28	0.67	95	2.95	99	2.22	21	3.2	88
	Eff	0.025		2.45		0.033		NF		1.76		0.36	
Fe	Inf	0.09	--	2.2	36	0.50	--	2.24	99	1.39	71	0.8	94
	Eff	0.10		1.4		0.80		NF		0.41		0.045	
Zn	Inf	NF	--	0.75	99	0.009	11	0.95	99	0.62	98	0.016	—
	Eff	NF		NF		0.008		NF		0.01		0.035	
Ni	Inf	NF	--	0.22	18	0.03	0	0.18	99	0.18	11	0.256	41
	Eff												

		HYDROGEN PEROXIDE		HYDROGEN PEROXIDE LIME PPT		HYDROGEN PEROXIDE ION EXCHANGE		HYDROGEN PEROXIDE FERRIC SULFATE		HYDROGEN PEROXIDE FERRIC CHLORIDE	
		Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction	Sample	Percent Reduction
Total CN	Inf	11.5	87	11.5	94	0.28	57	4.7	96	4.7	94
	Eff	1.46		0.70		0.12		0.18		0.26	
Free CN	Inf	8.1	86	8.1	98	0.12	87	3.6	99	3.6	99
	Eff	1.16		1.26		0.034		0.03		0.02	
SCN	Inf	--	--	--	--	89	2	--	--	--	--
	Eff	--		--		87		--		--	
Cu	Inf	2.03	6	2.03	82	0.64	92	1.9	96	1.9	95
	Eff	1.91		0.37		0.054		0.07		0.09	
Fe	Inf	1.31	92	1.31	68	0.017	62	1.0	89	1.0	89
	Eff	0.10		0.42		0.006		0.11		0.11	
Zn	Inf	0.345	98	0.345	97	0.024	79	0.06	67	0.06	83
	Eff	0.008		0.012		0.005		0.02		0.01	
Ni	Inf	0.165	67	0.165	89	0.099	20	0.18	50	0.18	61
	Eff										

[1] Sample units in mg/l

NF = none found

Inf = inflow

Eff = effluent

2.3 Land Application Studies

In order to dispose of treated process solution, the attenuation of metals and residual cyanide in area soils would have to be known. A series of studies were conducted in selected soils to determine the response of land application of simulated treated process solution. Five soil test pits were excavated (ST-2 through ST-6, Appendix F) along road cuts. An 18 by 18 inch horizontal excavation was made at depths ranging from 9 inches (ST-2) to 12-18 inches (ST-3 to 5), to 18 to 24 inches (ST-6) below the surface. A leachate collection system was devised to collect solution draining through the soil system.

Five gallons of process solution from each of four ponds was collected and diluted with 30 gallons (3:2) of ground water in a 55 gallon drum. The solution was then treated with NaHCL04 in two batches 24 hours apart. Cyanide was not detectable in a field Hach Kit cyanide test. Three gallons were addded to the soil surface. After roughly one half of the solution was collected as leachate, a second two gallon batch was applied. A second batch of leachate was then collected. This corresponded to a loading rate of 3.57 inches of solution.

Figures 12 through 17 show a comparison of process and leachate solution chemistry for each soil test pit. Total cyanide was only slightly less in leachate than in process solution indicating little attenuation (Figure 12). Chloride amenable cyanide was about 1 percent or less of total cyanide indicating that complexed forms (ferrocyanide) accounted for the majority of cyanide added. Chloride amenable cyanide appeared to increase as a result of the interaction with the soil system (Figure 13). Iron may be stripped from the ferrocyanide complex into adsorbed soil forms thus liberating some more soluble cyanide forms. The rapid movement of solution and lack of time for equilibration and biodegradation may account for the apparent mobility of complexed cyanide in these soils. It may be important to allow substantial residence time of cyanide solutions in soil.

Sodium removal by soils was very effective (80 to >95 %) as shown in Figure 14. Removal of arsenic was 15% in the shallow soil excavation (ST-2) but ranged to over 80 percent where 12 to 24 inches of soil was available for treatment (Figure 15). Removal of nickel was better than 80% (Figure 16). Mercury in leachate was generally below detection limits (0.001 mg/l) with removal efficiency better than 98 %. (Figure 17). Metal removal was substantial especially in light of the lack of time allowed for equilibration of the system. Additional data on process solution and leachate chemistry are shown in Appendix D.

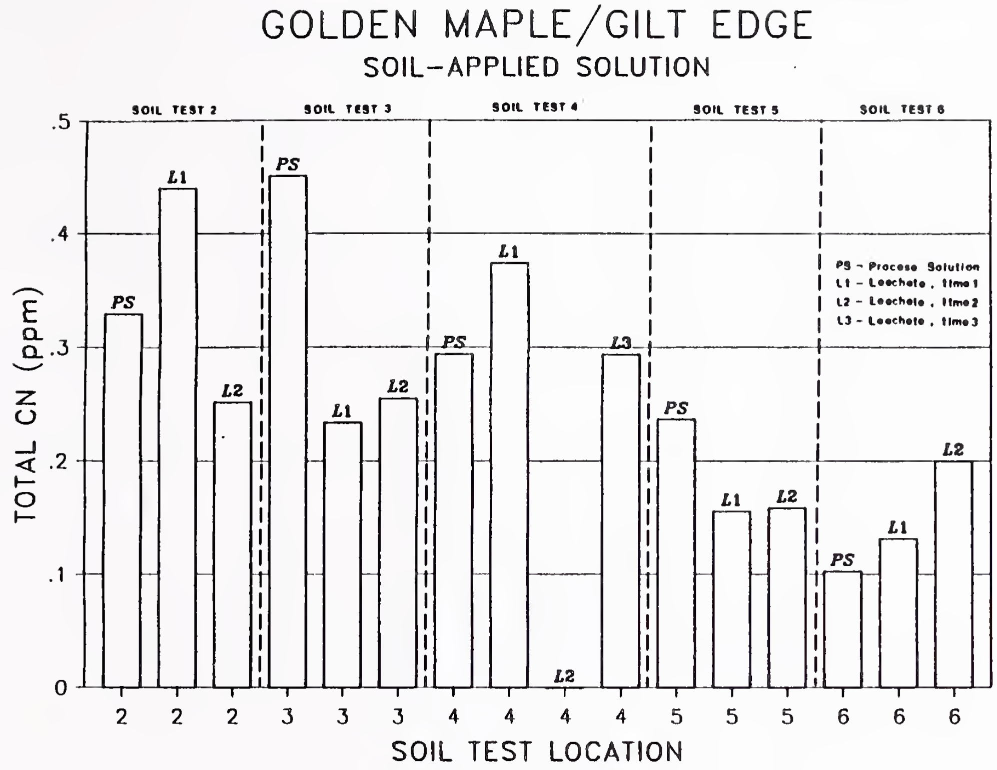


Figure 12. Removal of total cyanide from treated process solution by soils in the Golden Maple area.

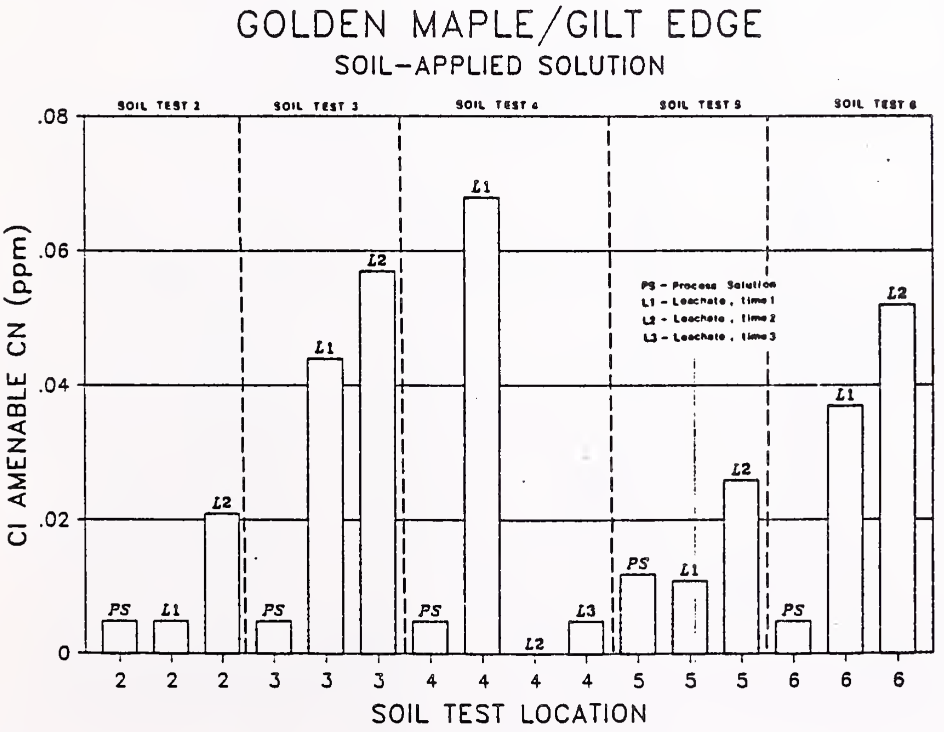


Figure 13. Removal of chloride amenable cyanide from treated process solution by soils in the Golden Maple area.

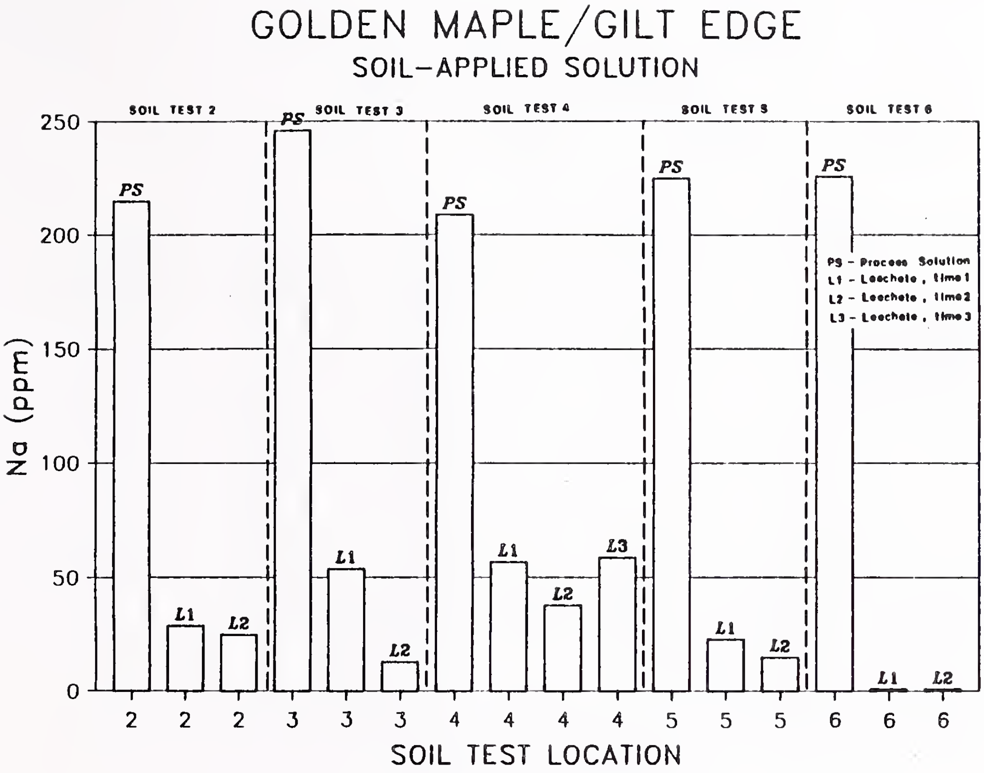


Figure 14. Removal of sodium from treated process solution by soils in the Golden Maple area.

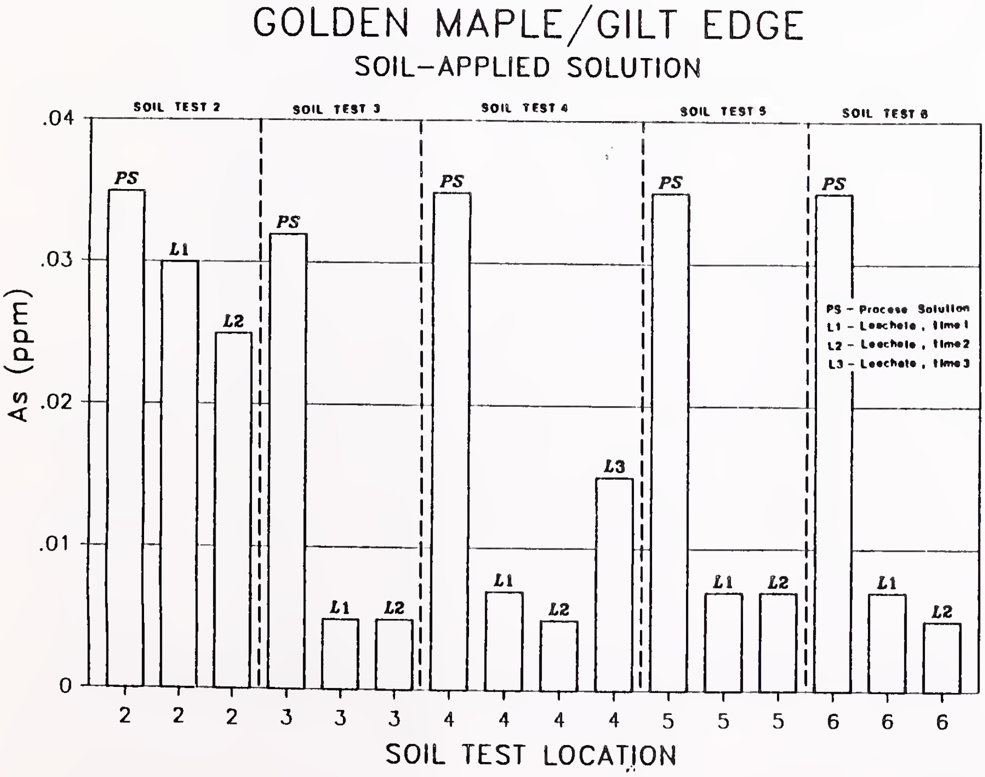


Figure 15. Removal of arsenic from treated process solution by soils in the Golden Maple area.

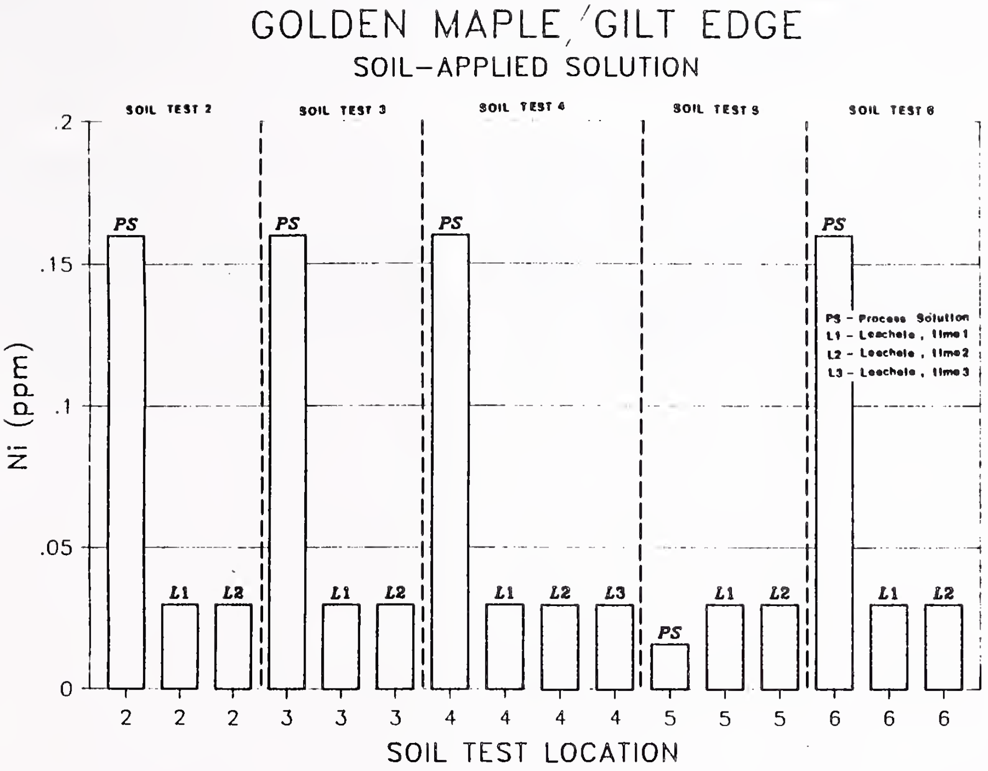


Figure 16. Removal of nickel from treated process solution by soils in the Golden Maple area.

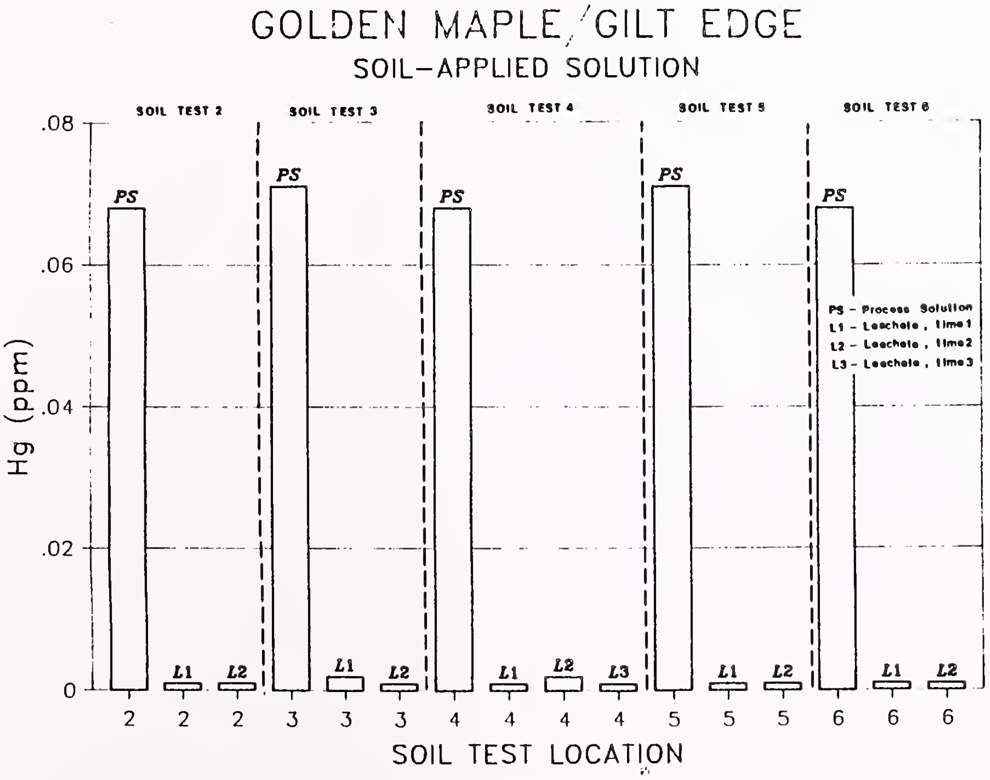


Figure 17. Removal of mercury from treated process solution by soils in the Golden Maple area.

Soils in the land application area were sampled before application of process solution. Soils were analysed for extractable metals in 5 percent acetic acid solution similar to the EP toxicity extractant. Data from the soil test pit areas are presented in Appendix A.

Recommended permissible loading rates for trace metals are shown in Table 4. Limits were obtained from literature pertaining to addition of municipal sludge to soils for production of agricultural crops. As such, the limits are conservative for forest land. A number of literature sources were consulted for permissible loading rates for arsenic, nickel, and mercury.

Table 4. Permissible loading rates of selected trace metals in forest soils.

Parameter	Maximum Loading (kg/ha)
Pb	2240 (1)
Zn	1120 (1)
Cu	560 (1)
Ni	140 (2)
Cd	20 (1)
As	10 (2)
Na	1200 (3)
Hg	2 (2)
Cr	1000 (2)

(1) Obtained from EPA Process Design Manual for Land Application of Municipal Sludge.

(2) from Matthews (1986).

(3) Sodium loading was calculated to maintain soil ESP below 10 %. A design safety factor of 2.0 was used. The soil CEC was assumed to average 20 meq/100g soil. Sodium was assumed to become equally mixed to 8 inches in depth.

2.4 Treatment Design Parameters

Based on the results of the soil loading studies it was felt that several guidelines could be developed to allow the safe application of treated process solution to Golden Maple soils. It was felt that sodium concentration and SAR of solutions should be reduced as low as possible through use of calcium hypochlorite as an oxidant. Solutions should have maximum residence time in soil. To assure this, soils should not be loaded beyond the upper water-holding capacity (-0.3 bars) at the base of the zone of treatment (18 to 24 inches). Further it was felt that solutions discharged should have less than 0.05 mg/l free cyanide, a specific conductance (EC) of less than 3500 micromhos per cm, and pH between 6.5 and 8.5.

3.0 REMEDIAL TREATMENT

3.1 Summary of Treatment

In mid-July of 1986, emergency water treatment and discharge was necessary to retain freeboard in the process ponds. Mr. Russ Dougdale of Butte was retained to treat and spray process solutions on a hillside southeast of the ponds. Approximately 40 inches of solution was applied to soils. Soil samples were collected after treatment from the emergency spray area. Moderate to severe foliar damage was noted in deciduous shrubs in the emergency spray area due to the high chloride content of the solutions. The sodium adsorption ratio of treated soils rose to 2 to 3 which should not impair soil permeability (Appendix A).

Landmark Reclamation was retained by the State of Montana to treat and dispose of cyanide bearing solutions at the Gilt Edge Mine Site. The four lined holding ponds were estimated, by State personnel, to contain 1.25 million gallons of process solutions and precipitation runoff (Figure 18 and 19). The pond solutions had an initial average concentration of approximately 1.1 mg/liter of free cyanide. The weighted average of electrical conductivity for the pond solutions was 2550 mmhos. The initial pH of the pond solutions varied from 8.0 to 8.2.

Land application of treated process solutions was selected as an acceptible method of disposal. The solutions were required to meet the following water quality standards, established by the State, prior to application in the land disposal area:

- Free Cyanide - Less than 0.05 mg/liter
- Electrical Conductivity - Less than 3500 mmhos
- pH - Between 6.5 and 8.5

Primary treatment to meet the cyanide concentration limit consisted of the neutral chlorination of process solutions using calcium hypochlorite, $Ca(OCl)2$. Details of the primary treatment are given in the final report submitted to the State by Landmark Reclamation (1986). The process solutions were treated in the process ponds. The treated solution was then pumped to the Intermediate Pond (Lake Jones) prior to delivery to the land application area.

A sprinkler irrigation system was used to apply solutions to the land disposal area. Figure 20 (Landmark Reclamation, 1986) illustrates the treatment and land application system. Landmark was required to sample and analyze treated solutions every two hours during its operations. Landmark was also required to monitor total depths of applied solutions and soil water

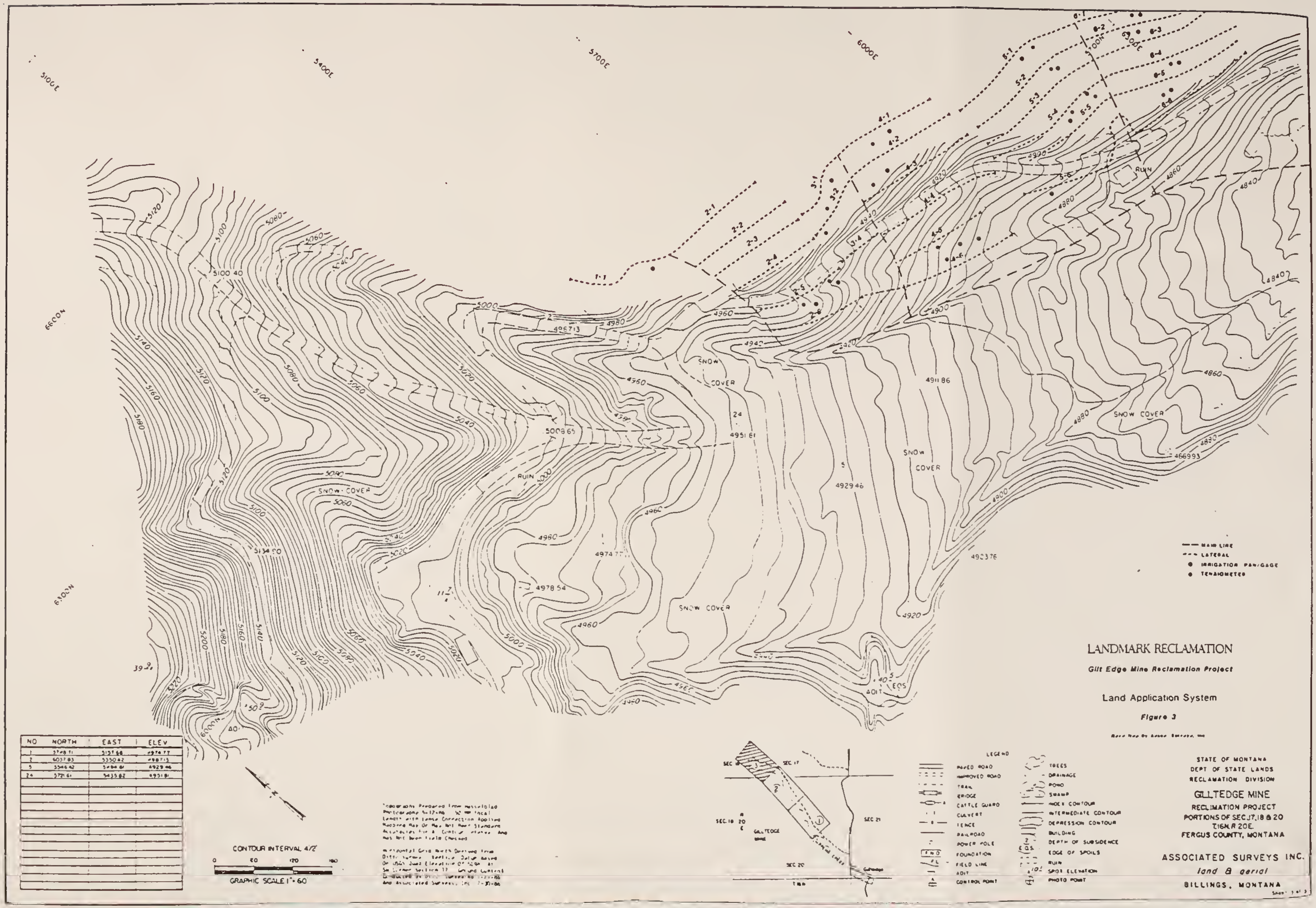
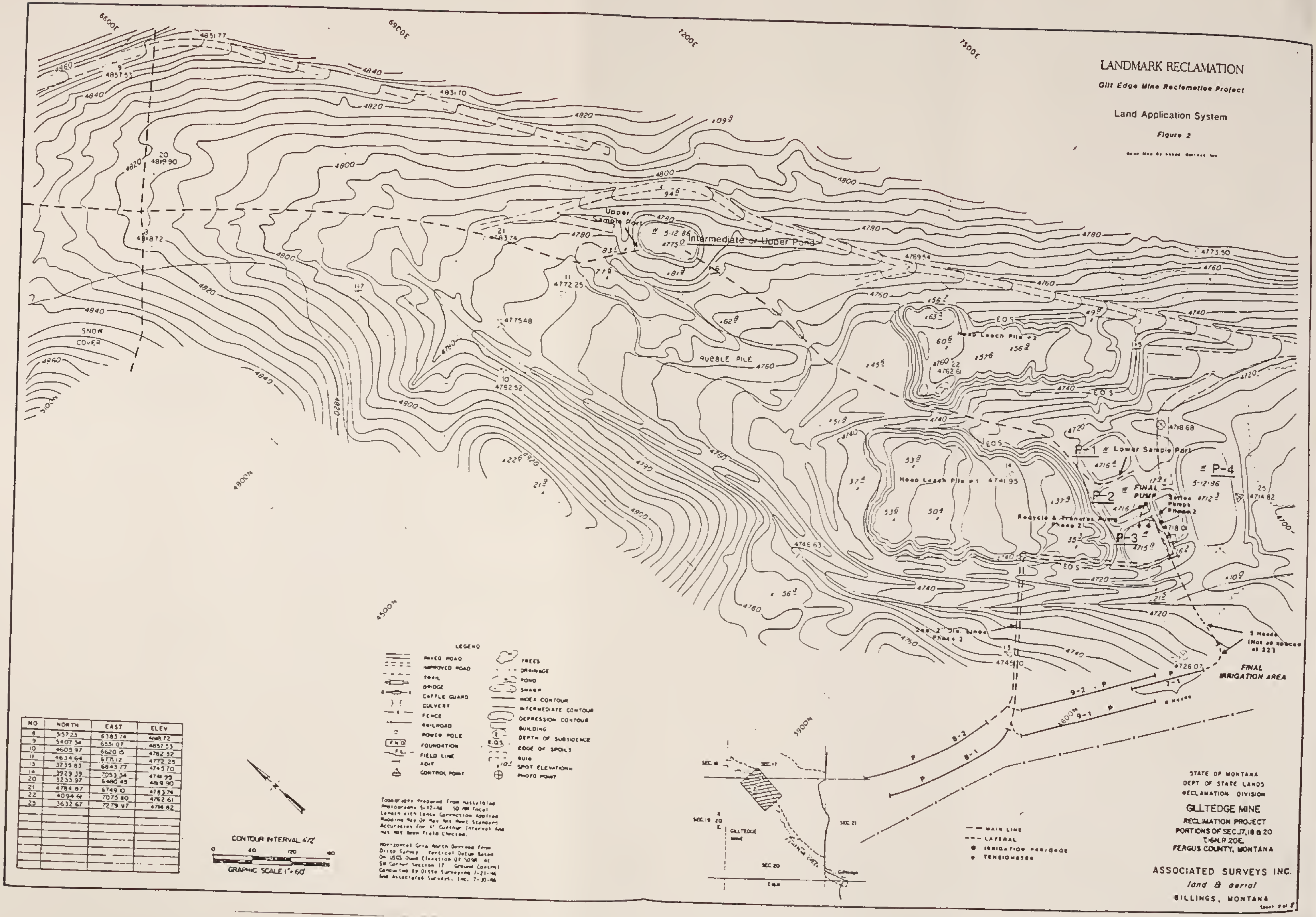


Figure 19. Layout of the Landmark process solution application system (east half).



NO	NORTH	EAST	ELEV
8	55723	6383 74	4818.72
9	5407 34	6551 07	4857 53
10	4605 97	6620 5	4782 52
11	4634 64	6771 12	4772 25
13	3735 83	6845 77	4745 70
14	3929 39	7053 34	4741 95
20	5233.97	6480 45	4819 90
21	4784 87	6749 10	4783 74
22	4094 61	7075 80	4762 61
25	3632 67	7279 97	4714 82

Figure 18. Layout of the Landmark process solution application system (west half).

potential in the land application area to remain within state guidelines for the project. Specific data and methods for the monitoring and sampling of applied solutions is given in Landmark's final report to the State. Land application of 586,000 gallons of solution occured from 24 August 1986 through 7 September 1986.

Pond sediments were initially treated with calcium hypochlorite and applied to the top of the Number 1 Heap Leach Pad. Due to the possible precious metal value of the pond sediment, the State notified Landmark to discontinue application of sediments to the heap leach pad. Sediments were then consolidated in Pond 1, associated solutions were decanted from the sediments, treated with calcium hypochlorite, and applied to one of the land disposal areas. The remaining sediments were then treated with calcium hypochlorite, stabilized with cement, and encapsulated using the Hypalon pond liners from Ponds 1 and 2. The remaining pond liners from Ponds 2, 3, and 4 were removed and encapsulated with the sediments in Pond 1.

Heavy rains during the two weeks following the completion of the project resulted in the partial refilling of process ponds on the site. The State requested that Landmark return to the site 2 October to 8 October 1986 to treat and dispose of the additional solutions as part of a change order to the original contract. Solutions were treated and disposed of as in the first phase. Approximately 147,000 gallons of treated solution was disposed of as part of Phase 2.

3.2 Metal Loading Rates

Field notes from the Landmark report were used to calculate the loading rate of cyanide and metals in process solutions applied to area soils. Spray irrigation areas are shown in Figure 18. The irrigation system consisted of three 220 foot long laterals with 10 risers each supplied with low pressure, (30 psi) low-trajectory heads. Laterals were placed 40 feet apart on center providing 80 percent overlap. A meter was used to measure process solution actually applied onto each irrigated area. Areas irrigated were taken from supplied maps to calculate the depth of water applied. Metal and cyanide content of process solution was taken by averaging values from irrigation water analyses and from cyanide content in Lake Jones just before land application (Appendix D). Concentration and water depth data were used to calculate loading rates for cyanide, sodium, chloride, and trace elements (Table 5).

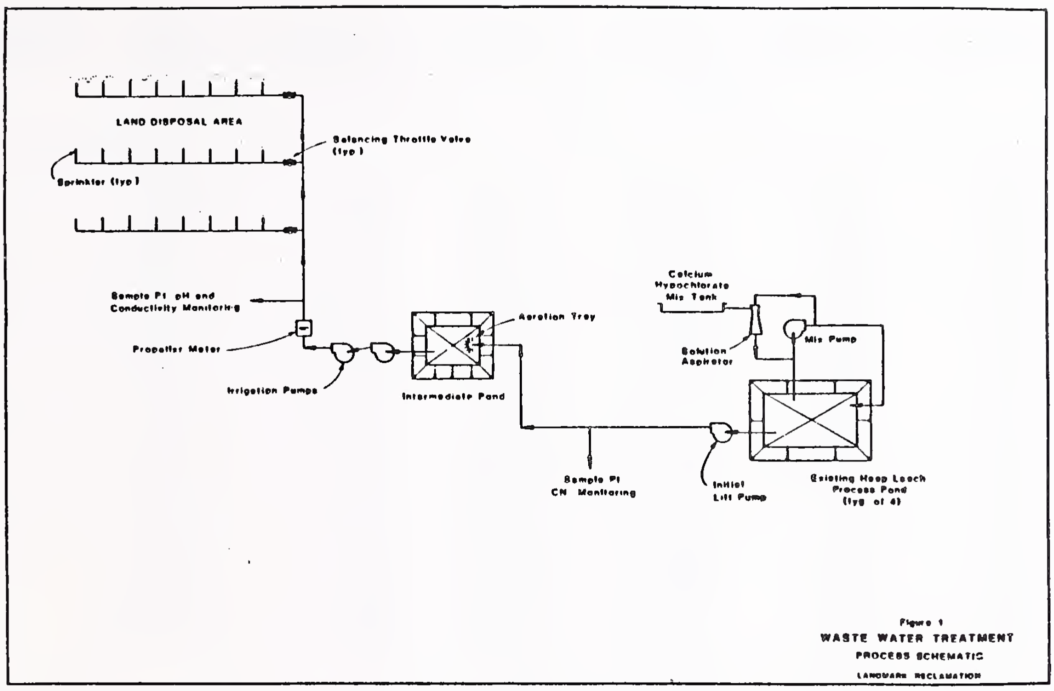


Figure 20. Schematic of process solution treatment system.

Table 5. Calculated metal and cyanide loading on the land application area.

LOCATION	DEPTH of H2O (cm)	AREA (ha)	TOTAL CN	Cl AMEN. CN	SODIUM	CHLORIDE
			(kg/ha)			
1	3.81	0.127	.243	.005	164.5	36.4
2a	12.14	0.262	.775	.016	540.2	115.9
2b	7.8	0.292	.498	.010	347.1	74.5
3a	14.48	0.093	.924	.019	644.4	138.3
3b	2.08	0.140	.133	.003	92.6	19.9
4a	8.53	0.295	.544	.011	379.6	81.5
4b	.48	0.336	.031	.001	21.4	4.6
5a	5.94	0.319	.379	.008	264.3	56.7
5b	6.55	0.424	.418	.009	291.5	62.6
6a	4.85	0.254	.309	.006	215.8	46.3
6b	6.88	0.285	.439	.009	306.2	65.7
7	8.89	0.112	.567	.012	395.6	84.9
8	12.98	0.252	.828	.017	577.6	124.0
9	9.12	0.252	.582	.012	405.8	87.1
MEAN	7.47	0.246	.476	.010	332.3	71.3

Table 5. (continued).

LOCATION	DEPTH of H2O (cm)	ARSENIC	MERCURY	LEAD (kg/ha)	CADMIUM	CHROME	ZINC
1	3.81	.133	.021	.004	.011	.008	.080
2a	12.14	.425	.067	.012	.035	.024	.255
2b	7.8	.273	.043	.008	.023	.016	.164
3a	14.48	.507	.080	.014	.042	.029	.304
3b	2.08	.073	.011	.002	.006	.004	.044
4a	8.53	.299	.047	.009	.025	.017	.179
4b	.48	.017	.003	.001	.001	.001	.010
5a	5.94	.208	.033	.006	.017	.012	.125
5b	6.55	.229	.036	.007	.019	.013	.138
6a	4.85	.170	.027	.005	.014	.010	.102
6b	6.88	.241	.038	.007	.020	.014	.144
7	8.89	.311	.049	.009	.026	.018	.187
8	12.98	.454	.071	.013	.038	.026	.273
9	9.12	.319	.050	.009	.026	.018	.192
MEAN	7.47	.261	.041	.008	.022	.015	.157

All values for metal loading were well within acceptable limits for land application taken from the literature. It appears that sodium, mercury, and arsenic loading are most likely to be limiting in land application systems of treated process solutions. Data were not available for acceptable cyanide loading rates.

3.3 Post-Reclamation Monitoring

Soils data were collected from the land application area after treatment to measure the effects of land application on metal, sodium, and cyanide accumulation. Water soluble cyanide (saturation extract) was measured as a function of depth (Figure 21). Most total cyanide analyses were below detection limits due to high limits of instrument detection (0.2 mg/kg). Apparent cyanide loading was calculated by assuming an average of 0.17 mg/kg in the upper 5 inches, 0.12 mg/kg from 5 to 10 inches and a background of 0.08 mg/kg (inferred from levels below 10 inches). The apparent cyanide loading was 0.21 kg/ha which is roughly 50 percent of total loading (Table 5). Where total cyanide concentrations are detectable, they are roughly twice the soluble cyanide indicating that little translocation or biodegradation of cyanide likely occured. The high fraction of complexed cyanide in the soluble fraction indicates weak interaction of the complexes with soil components.

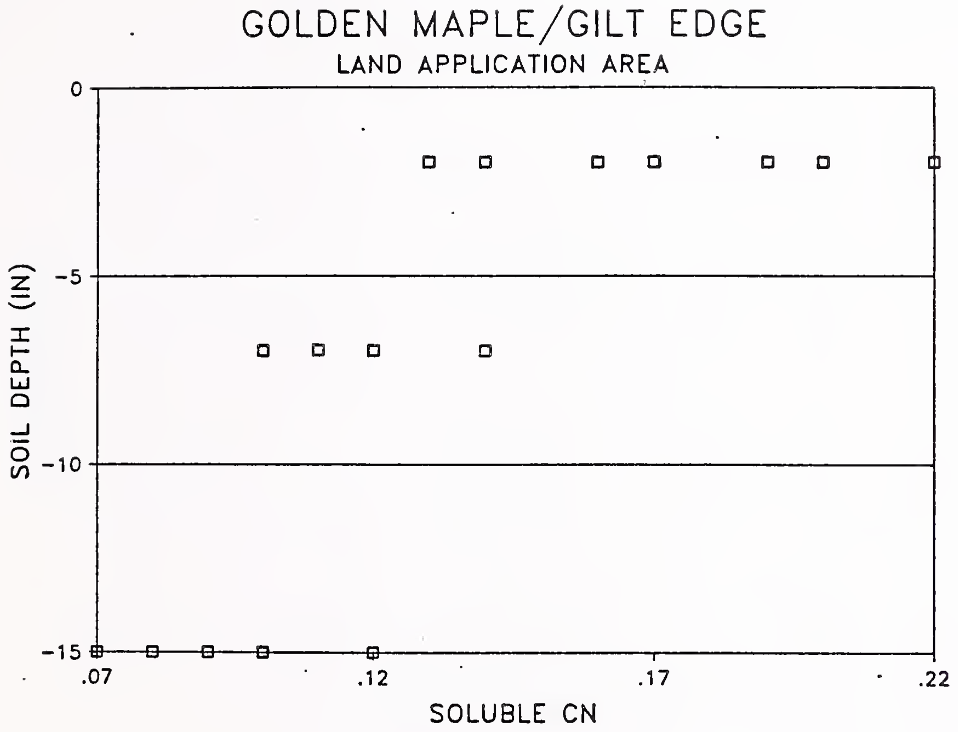


Figure 21. Soluble cyanide in soils after land application of process solution at Golden Maple.

Soil organic matter levels in these soils was quite high (Figure 22) which may account for the attenuation of soluble cyanide in the surface layers. Soil rganic matter was mesured by weight loss during low-temperature ignition so some inorganic carbon may have been included in the organic carbon estimate. Sodium accumulation was not a problem in the land application area (Figure 23) despite a similar amount of water being applied (2.94 inches) as in the soil test pit studies (3.57 inches). The use of calcium rather than sodium hypochlorite is responsible for the difference in sodium loading and in the equilibrium SAR (3 to 4 at the surface). Extractable arsenic (5 % acetic acid) appeared to be slightly elevated near the surface. The quantitv of increase appeared to be consistent with the average As loading (Figure 24).

Extractable manganese and iron ranged from 20 to 200 mg/kg and 2 to 150 mg/kg respectively (Appendix A). Concentrations of these metals often increased with depth so that it was doubtful that metal levels were elevated as a consequence of the application of process solution. While extractable zinc ranged from 0.3 to 3.8 mg/kg, the distribution in the profile did not indicate an appreciable increase due to land application. Levels of mercury, cadmium, and lead were at or near the detection

limits for all samples tested. Nickel concentration ranged from detection to 0.7 mg/kg and was highest at depth.

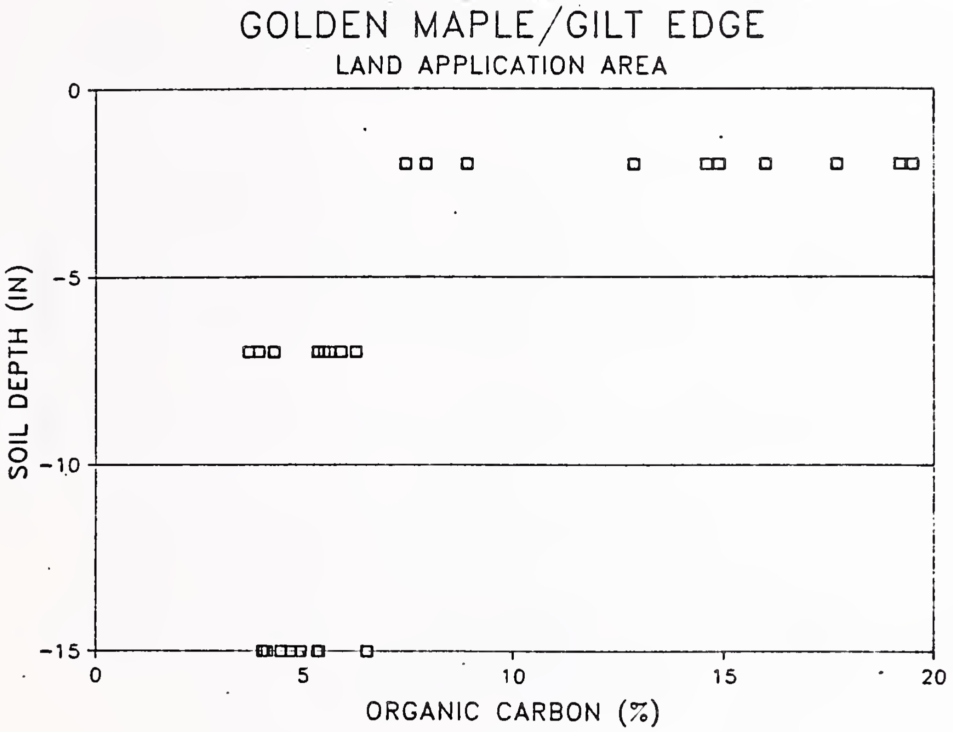


Figure 22. Organic matter in soils after land application of process solution at Golden Maple.

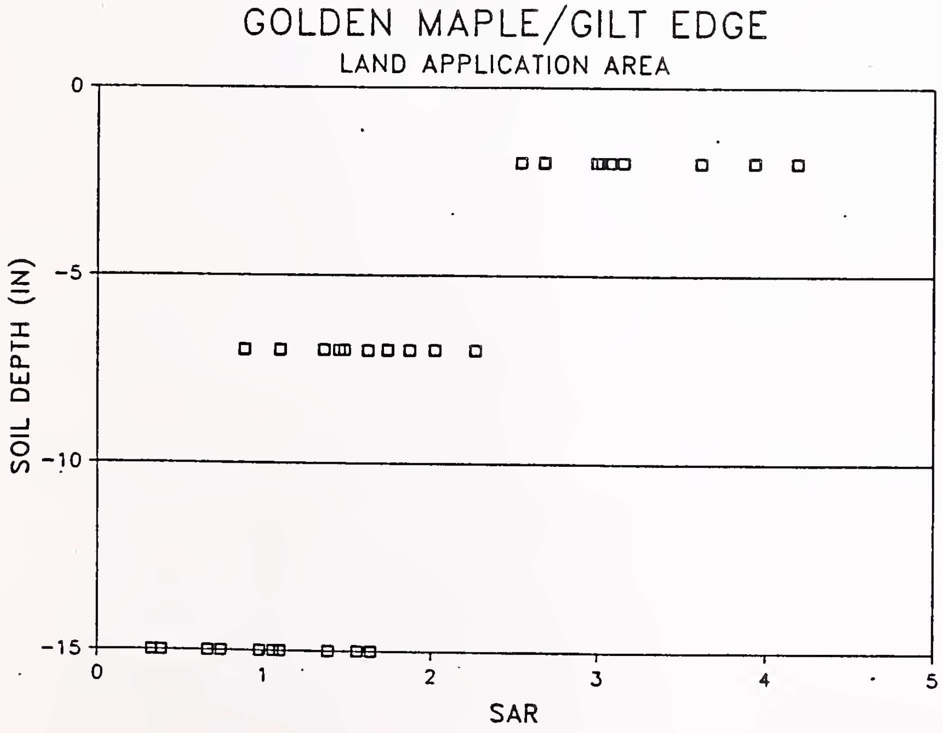


Figure 23. Sodium adsorption ratio in soils after land application of process solution at Golden Maple.

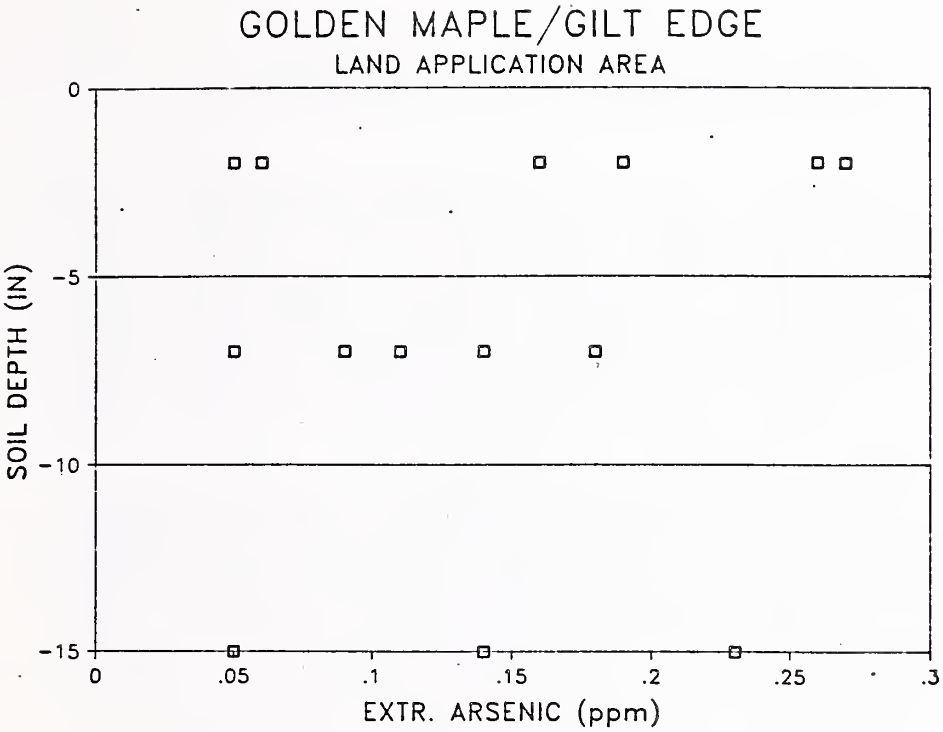


Figure 24. Extractable arsenic in soils after land application of process solution at Golden Maple.

4.0 CONCLUSIONS AND RECOMMENDATIONS

- Total cyanide appeared to move readily through test area soils indicating that land treatment of process solution may not attenuate complexed cyanide. Maximum residence time within the soil system must be insured for biodegradation of cyanide. Solution volume should therefore be limited to the maximum amount of solution that can be retained by the soil system.

- Tensiometers were difficult to use in the field during irrigation as a means of determining the presence of saturated conditions at depth. An alternative means of determining loading rate would be to measure antecedent water content and water-holding capacity at -0.3 bars of suction. The difference between actual water content and water content at -0.3 bars would provide the permissable water application volume.

- Process solutions with 0.3 to 0.5 mg/l total cyanide and less than 0.005 mg/l chloride amenable cyanide were aplied to soils. Though a small fraction of the toal cyanide applied was retained by soil, the chloride-amenable fraction increased by more than ten-fold in some cases. Conversion of complexed cyanide (unavailable to organisms) to amenable cyanide (available to organisms) in soil is a potential drawback to land treatment. In recognition of this potential threat EPA recently banned land disposal of cyanide wastes through their RCRA program. Further research on the transformations of complexed cyanide in soils used for land treatment is recommended. Unsaturated soil column studies to collect cyanide solution leachate with varying loading rates and residence times would provide essential information.

- Field cyanide tests are often used to monitor treatment efficiency during land application projects. Field test methods are known to have many interferences including thiocyanate which is likely to be abundant in treated process solutions. For both field and laboratory testing, reference cyanide solutions containing potential interferents should be analysed to provide a level of quality assurance for cyanide measurements.

- Use of soil amendments to enhance cyanide attenuation and biodegradation should also be investigated as a

potentially cost-effective way to land treat process solutions.

- Vadose zone monitoring of land application areas using suction lysimeters is advisable as a means of 1) assessing the concentration of key contaminants in leachate to ground water, 2) to monitor biodegradation of cyanide in soil and 3) to monitor flux of other metals applied to soils.

- Accurate control of pH during alkaline oxidation of cyanide solutions and solution circulation (mixing) is imperative to obtain maximum process efficiency. Use of NaOH and HCl to control pH is recommended where necessary to control solution pH.

- The primary design parameters for implementing land application should include determination of soil water deficit, maximum irrigation rate (not to exceed soil infiltration rate), sodium loading (to prevent sodium build-up which is deleterious to permeability), and metal loading.

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APPENDIX A
SOIL CHEMICAL AND PHYSICAL DATA
SOIL LEACH TEST, EMERGENCY SPRAY AREA, AND LAND APPLICATION AREAS

Table A-1. Soil physical data for the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
PHYSICAL CHARACTERISTICS

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	COARSE FRAGMENTS (%)	SAND (%)	SILT (%)	CLAY (%)	VFS (%)	TEXTURE (SCS CLASS)	ORGANIC CARBON (%)
** SAMPLE LOCATION : BL										
GMST-3	06/13/86	0	8	0.0	52	32	16	0	L	6.28
GMST4	06/13/86	0	2	0.0	46	34	20	0	L	8.33
GMST4	06/13/86	2	14	0.0	44	38	18	0	L	3.52
GMST4	06/13/86	16	20	0.0	26	52	22	0	SIL	3.55
GMST5	06/13/86	1	8	0.0	20	46	34	0	SICL	8.62
GMST5	06/13/86	8	18	0.0	28	44	28	0	CL	7.96
GMST6	06/13/86	0	4	0.0	20	54	26	0	SIL	13.60
GMST6	06/13/86	4	16	0.0	14	56	30	0	SICL	8.30
** SAMPLE LOCATION : ES										
EMSPRAY1SW	07/17/86	0	4	0.0	24	52	24	0	SIL	18.90
EMSPRAY1SW	07/17/86	4	10	0.0	30	42	28	0	CL	11.30
EMSPRAY2SW	07/17/86	0	4	0.0	26	52	22	0	SIL	21.30
EMSPRAY2SW	07/17/86	4	10	0.0	20	54	26	0	SIL	17.40
EMSPRAY1NE	07/17/86	0	4	0.0	44	38	18	0	L	6.96
EMSPRAY1NE	07/17/86	4	10	0.0	46	36	18	0	L	5.53
EMSPRAY2NE	07/17/86	0	4	0.0	34	48	18	0	L	18.40
EMSPRAY2NE	07/17/86	4	10	0.0	32	44	24	0	L	8.84
EMSPRAY1ASW	07/22/86	0	4	0.0	28	46	26	0	L	12.50
EMSPRAY1ASW	07/22/86	4	10	0.0	18	44	38	0	SICL	8.70
EMSPRAY2ASW	07/22/86	0	4	0.0	0	0	0	0		15.40
EMSPRAY2ASW	07/22/86	4	10	0.0	20	44	36	0	SICL	9.39
** SAMPLE LOCATION : STP										
TP1	08/04/86	0	2	34.3	68	30	2	9	SL	0.00
TP1	08/04/86	2	4	31.4	68	28	4	13	SL	0.00
TP1	08/04/86	4	6	30.8	78	16	6	25	LS	0.00
TP1	08/04/86	6	8	29.9	58	37	5	5	SL	0.00
TP2	08/04/86	0	8	29.5	64	31	5	9	SL	0.00
TP3	08/04/86	0	8	26.5	66	27	7	14	SL	0.00
TP4	08/04/86	0	2	28.4	62	31	7	9	SL	0.00
TP4	08/04/86	2	4	25.2	66	29	5	10	SL	0.00
TP4	08/04/86	4	6	25.2	60	35	5	7	SL	0.00
TP4	08/04/86	6	8	29.6	60	31	9	9	SL	0.00
TP5	08/04/86	0	8	21.1	64	31	5	8	SL	0.00
TP6	08/04/86	0	8	29.8	56	35	9	6	SL	0.00
TP7	08/04/86	0	2	18.7	22	57	21	1	SIL	0.00
TP7	08/04/86	2	4	23.7	56	35	9	7	SL	0.00
TP7	08/04/86	4	6	27.2	54	35	11	9	SL	0.00
TP7	08/04/86	6	8	26.9	56	35	9	7	SL	0.00

Table A-1 (continued).

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
PHYSICAL CHARACTERISTICS

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	COARSE FRAGMENTS (%)	SAND (%)	SILT (%)	CLAY (%)	VFS (%)	TEXTURE (SCS CLASS)	ORGANIC CARBON (%)
** SAMPLE LOCATION : LA										
1NA	09/09/86	0	4	0.0	34	44	22	0	L	7.44
1NA	09/09/86	4	10	0.0	44	38	18	0	L	3.93
1NA	09/09/86	10	20	0.0	48	36	16	0	L	4.06
1NB	09/09/86	4	10	0.0	36	40	24	0	L	5.90
1NB	09/09/86	10	20	0.0	36	44	20	0	L	6.52
2NA	09/09/86	0	4	0.0	42	42	16	0	L	17.70
2NA	09/09/86	4	10	0.0	42	36	22	0	L	5.35
2NA	09/09/86	10	20	0.0	40	38	22	0	L	5.34
2NB	09/09/86	0	4	0.0	46	40	14	0	L	14.90
2NB	09/09/86	4	10	0.0	42	36	22	0	L	6.25
2NB	09/09/86	10	20	0.0	40	34	26	0	L	4.47
3NA	09/09/86	0	4	0.0	44	44	12	0	L	14.60
3NA	09/09/86	4	10	0.0	46	34	20	0	L	5.62
3NA	09/09/86	10	20	0.0	44	38	18	0	L	5.38
3NB	09/09/86	0	4	0.0	40	48	12	0	L	16.00
3NB	09/09/86	4	10	0.0	46	34	20	0	L	5.49
3NB	09/09/86	10	20	0.0	46	34	20	0	L	4.46
4NA	09/09/86	0	4	0.0	0	0	0	0		19.50
4NA	09/09/86	4	10	0.0	50	30	20	0	L	5.90
4NA	09/09/86	10	20	0.0	50	26	24	0	SCL	4.13
4NB	09/09/86	0	4	0.0	0	0	0	0		19.20
4NB	09/09/86	4	10	0.0	0	0	0	0		3.68
4NB	09/09/86	10	20	0.0	48	33	19	0	L	4.71
5NA	09/09/86	0	4	0.0	0	0	0	0		8.90
5NA	09/09/86	4	10	0.0	36	40	24	0	L	5.34
5NA	09/09/86	10	20	0.0	46	32	22	0	L	4.94
5NB	09/09/86	0	4	0.0	44	38	18	0	L	12.90
5NB	09/09/86	4	10	0.0	44	38	18	0	L	4.29

BL = soil test pit area before leaching
ES = emergency process solution spray area
STP= soil test pit area after leaching
LA = operational land application area

Table A-2. Soil chemistry data (major cations) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
MAJOR CATIONS

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	pH	EC mmhos /cm	SATN. (%)	CALCIUM (meq/l)	MAGNESIUM (meq/l)	SODIUM (meq/l)	SAR
** SAMPLE LOCATION : BL										
GMST-3	06/13/86	0	8	7.0	0.57	41.0	4.53	0.54	0.22	0.14
GMST4	06/13/86	0	2	7.6	0.91	46.9	8.31	1.07	0.28	0.13
GMST4	06/13/86	2	14	8.0	1.00	32.7	6.70	1.78	1.56	0.76
GMST4	06/13/86	16	20	8.0	0.42	40.3	2.55	0.93	0.18	0.14
GMST5	06/13/86	1	8	7.4	0.83	55.3	7.28	0.51	0.39	0.20
GMST5	06/13/86	8	18	7.6	0.62	47.0	6.49	0.34	0.21	0.11
GMST6	06/13/86	0	4	7.5	0.83	65.5	8.63	0.47	0.18	0.08
GMST6	06/13/86	4	16	7.7	0.62	53.9	5.71	0.28	0.17	0.10
** SAMPLE LOCATION : ES										
EMSPRAY1SW	07/17/86	0	4	6.6	0.78	66.1	7.25	0.77	0.02	0.01
EMSPRAY1SW	07/17/86	4	10	7.5	0.69	46.4	6.85	0.67	0.11	0.05
EMSPRAY2SW	07/17/86	0	4	6.7	0.71	72.0	6.95	0.84	0.02	0.01
EMSPRAY2SW	07/17/86	4	10	7.0	0.64	62.2	5.90	0.53	0.02	0.01
EMSPRAY1NE	07/17/86	0	4	7.5	1.41	33.4	8.68	1.01	5.64	2.56
EMSPRAY1NE	07/17/86	4	10	7.7	1.52	26.9	7.32	0.96	6.44	3.17
EMSPRAY2NE	07/17/86	0	4	7.5	1.30	60.7	6.77	0.68	6.25	3.24
EMSPRAY2NE	07/17/86	4	10	7.5	2.39	41.0	13.80	1.44	9.98	3.62
EMSPRAY1ASW	07/22/86	0	4	7.2	1.26	59.8	6.25	0.79	6.11	3.26
EMSPRAY1ASW	07/22/86	4	10	7.1	1.68	57.0	14.50	1.45	3.19	1.13
EMSPRAY2ASW	07/22/86	0	4	7.4	1.46	65.3	8.25	0.77	5.36	2.52
EMSPRAY2ASW	07/22/86	4	10	7.4	1.43	57.5	6.53	1.38	6.63	3.33
** SAMPLE LOCATION : STP										
TP1	08/04/86	0	2	8.6	1.73	22.6	10.20	0.35	8.04	3.50
TP1	08/04/86	2	4	9.0	2.69	21.4	5.00	0.30	24.50	15.10
TP1	08/04/86	4	6	8.8	2.25	18.2	1.34	0.56	21.00	21.60
TP1	08/04/86	6	8	8.7	1.90	19.1	2.13	0.23	16.30	15.00
TP2	08/04/86	0	8	9.0	2.50	19.9	4.75	0.23	21.80	13.80
TP3	08/04/86	0	8	8.2	1.75	21.9	2.54	0.65	14.20	11.20
TP4	08/04/86	0	2	8.5	0.40	22.3	1.06	0.16	2.08	2.66
TP4	08/04/86	2	4	8.7	1.04	17.4	0.58	0.11	9.68	16.50
TP4	08/04/86	4	6	8.7	1.01	17.4	0.57	0.20	10.20	16.40
TP4	08/04/86	6	8	8.6	1.43	17.6	0.82	0.48	13.20	16.40
TP5	08/04/86	0	8	8.8	1.42	16.3	0.50	0.23	15.20	25.20
TP6	08/04/86	0	8	8.5	1.29	22.2	2.52	0.23	10.40	8.87
TP7	08/04/86	0	2	8.6	0.51	31.7	0.35	0.06	4.39	9.70
TP7	08/04/86	2	4	8.5	1.59	21.1	1.60	0.41	14.80	14.80
TP7	08/04/86	4	6	8.3	1.22	23.9	1.42	0.30	10.30	11.10
TP7	08/04/86	6	8	8.4	0.38	19.6	0.35	0.07	2.43	5.30

Table A-2 (continued).

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
MAJOR CATIONS

** SAMPLE LOCATION : LA

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	pH	EC mmhos /cm	SATN. (%)	CALCIUM (meq/l)	MAGNESIUM (meq/l)	SODIUM (meq/l)	SAR
1NA	09/09/86	0	4	7.5	1.91	53.8	12.40	1.13	7.97	3.07
1NA	09/09/86	4	10	7.7	1.92	43.5	12.90	2.40	4.48	1.62
1NA	09/09/86	10	20	7.7	1.35	42.4	10.90	0.78	2.55	1.06
1NB	09/09/86	4	10	7.6	1.55	50.7	11.80	1.14	3.45	1.36
1NB	09/09/86	10	20	7.6	1.47	49.3	11.40	1.08	3.46	1.39
2NA	09/09/86	0	4	6.8	2.58	81.3	15.10	3.71	8.19	2.67
2NA	09/09/86	4	10	6.8	1.60	45.1	10.90	1.67	3.63	1.45
2NA	09/09/86	10	20	6.8	1.03	43.0	7.22	1.13	1.54	0.75
2NB	09/09/86	0	4	7.1	2.24	69.3	15.20	2.09	7.44	2.53
2NB	09/09/86	4	10	7.4	1.68	48.2	12.30	1.29	4.88	1.87
2NB	09/09/86	10	20	7.6	1.37	46.7	11.10	1.16	2.74	1.10
3NA	09/09/86	0	4	7.4	2.99	75.8	19.60	1.93	10.30	3.15
3NA	09/09/86	4	10	7.4	1.91	47.0	14.60	1.35	4.18	1.48
3NA	09/09/86	10	20	7.6	1.46	43.3	11.30	1.22	1.69	0.67
3NB	09/09/86	0	4	6.9	2.64	80.8	14.60	1.68	11.20	3.93
3NB	09/09/86	4	10	7.3	1.76	42.8	15.60	1.79	3.25	1.10
3NB	09/09/86	10	20	7.5	1.40	40.2	14.00	1.11	0.91	0.33
4NA	09/09/86	0	4	6.9	2.60	93.2	16.30	2.02	9.04	2.99
4NA	09/09/86	4	10	7.2	1.74	45.4	14.70	1.22	2.50	0.89
4NA	09/09/86	10	20	7.7	0.95	41.6	8.09	0.73	0.82	0.39
4NB	09/09/86	0	4	7.0	2.69	93.8	16.00	1.98	10.80	3.61
4NB	09/09/86	4	10	7.6	1.69	38.9	11.60	0.71	5.01	2.02
4NB	09/09/86	10	20	7.6	1.70	41.7	14.30	1.22	4.56	1.64
5NA	09/09/86	0	4	7.0	2.04	51.8	12.50	1.93	8.12	3.02
5NA	09/09/86	4	10	7.7	1.42	48.7	10.70	1.04	4.20	1.74
5NA	09/09/86	10	20	7.7	1.39	43.1	10.90	1.12	3.81	1.56
5NB	09/09/86	0	4	7.1	2.74	72.1	17.00	2.82	13.20	4.19
5NB	09/09/86	4	10	7.8	1.33	40.2	8.51	1.05	4.95	2.26

BL = soil test pit area before leaching
ES = emergency process solution spray area
STP= soil test pit area after leaching
LA = operational land application area

Table A-3. Soil chemistry (cyanide) data from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
CYANIDE CHEMISTRY

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	CEC meq/100g	TOTAL CYANIDE (mg/kg)	SOLUBLE CYANIDE (mg/kg)	CHLORIDE (mg/kg)
** SAMPLE LOCATION : BL							
GMST-3	06/13/86	0	8	19.90	0.13	0.05 B	0.0
GMST4	06/13/86	0	2	19.60	0.28	0.05 B	0.0
GMST4	06/13/86	2	14	6.11	0.07	0.05 B	0.0
GMST4	06/13/86	16	20	8.98	0.05	0.05 B	0.0
GMST5	06/13/86	1	8	33.30	3.56	0.05 B	0.0
GMST5	06/13/86	8	18	28.90	0.09	0.05 B	0.0
GMST6	06/13/86	0	4	49.00	0.25	0.05 B	0.0
GMST6	06/13/86	4	16	38.30	0.10	0.05 B	0.0
** SAMPLE LOCATION : ES							
EMSPRAY1SW	07/17/86	0	4	55.00	0.62	0.05 B	0.0
EMSPRAY1SW	07/17/86	4	10	37.90	0.14	0.05 B	0.0
EMSPRAY2SW	07/17/86	0	4	56.90	0.70	0.05 B	0.0
EMSPRAY2SW	07/17/86	4	10	53.60	0.44	0.05 B	0.0
EMSPRAY1NE	07/17/86	0	4	18.70	60.00	0.08	0.0
EMSPRAY1NE	07/17/86	4	10	17.10	120.00	0.07	0.0
EMSPRAY2NE	07/17/86	0	4	49.40	0.54	0.07	0.0
EMSPRAY2NE	07/17/86	4	10	28.20	0.32	0.09	0.0
EMSPRAY1ASW	07/22/86	0	4	37.60	0.54	0.09	0.0
EMSPRAY1ASW	07/22/86	4	10	35.80	0.20	0.06	0.0
EMSPRAY2ASW	07/22/86	0	4	42.60	2.44	0.06	0.0
EMSPRAY2ASW	07/22/86	4	10	36.40	1.16	0.08	0.0
** SAMPLE LOCATION : STP							
TP1	08/04/86	0	2	0.00	0.20 B	0.00	1.0 B
TP1	08/04/86	2	4	0.00	0.60	0.00	1.0 B
TP1	08/04/86	4	6	0.00	0.20	0.00	1.0 B
TP1	08/04/86	6	8	0.00	3.40	0.00	1.0 B
TP2	08/04/86	0	8	0.00	1.00	0.00	6.0
TP3	08/04/86	0	8	0.00	1.60	0.00	4.0
TP4	08/04/86	0	2	0.00	0.20 B	0.00	2.0
TP4	08/04/86	2	4	0.00	0.20	0.00	1.0 B
TP4	08/04/86	4	6	0.00	0.40	0.00	4.0
TP4	08/04/86	6	8	0.00	0.40	0.00	1.0 B
TP5	08/04/86	0	8	0.00	0.80	0.00	1.0 B
TP6	08/04/86	0	8	0.00	2.40	0.00	1.0 B
TP7	08/04/86	0	2	0.00	1.60	0.00	1.0 B
TP7	08/04/86	2	4	0.00	0.80	0.00	1.0 B
TP7	08/04/86	4	6	0.00	0.40	0.00	1.0 B
TP7	08/04/86	6	8	0.00	0.20	0.00	1.0 B

Table A-3 (continued).

GOLDEN MAPLE / GILT EDGE MINE
SOIL CHEMISTRY DATA
CYANIDE CHEMISTRY

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	CEC meq/100g	TOTAL CYANIDE (mg/kg)	SOLUBLE CYANIDE (mg/kg)	CHLORIDE (mg/kg)
** SAMPLE LOCATION : LA							
1NA	09/09/86	0	4	18.50	0.30	0.16	27.4
1NA	09/09/86	4	10	10.40	0.20 B	0.10	25.1
1NA	09/09/86	10	20	11.00	0.20 B	0.09	24.4
1NB	09/09/86	4	10	16.60	0.20	0.11	25.6
1NB	09/09/86	10	20	16.70	0.20 B	0.12	28.3
2NA	09/09/86	0	4	36.20	0.20 B	0.17	65.1
2NA	09/09/86	4	10	15.10	0.20 B	0.11	32.8
2NA	09/09/86	10	20	14.70	0.20 B	0.08	23.1
2NB	09/09/86	0	4	30.20	0.20 B	0.13	58.1
2NB	09/09/86	4	10	17.50	0.20 B	0.12	32.8
2NB	09/09/86	10	20	13.00	0.20	0.10	26.0
3NA	09/09/86	0	4	42.90	0.20 B	0.17	57.5
3NA	09/09/86	4	10	17.10	0.20 B	0.12	26.8
3NA	09/09/86	10	20	14.20	0.20 B	0.10	18.9
3NB	09/09/86	0	4	36.20	0.20 B	0.19	57.8
3NB	09/09/86	4	10	30.00	0.20 B	0.14	27.0
3NB	09/09/86	10	20	12.90	0.20 B	0.10	23.6
4NA	09/09/86	0	4	42.90	0.30	0.20	0.0
4NA	09/09/86	4	10	14.70	0.20 B	0.10	26.1
4NA	09/09/86	10	20	13.30	0.20 B	0.07	12.0
4NB	09/09/86	0	4	43.20	0.30	0.22	61.8
4NB	09/09/86	4	10	11.40	0.20 B	0.10	23.4
4NB	09/09/86	10	20	14.80	0.20	0.10	37.8
5NA	09/09/86	0	4	21.10	0.20 B	0.14	13.6
5NA	09/09/86	4	10	15.80	0.20 B	0.10	15.9
5NA	09/09/86	10	20	13.30	0.20 B	0.10	14.3
5NB	09/09/86	0	4	29.90	0.20 B	0.20	36.4
5NB	09/09/86	4	10	13.10	0.20 B	0.10	13.9

BL = soil test pit area before leaching
ES = emergency process solution spray area
STP= soil test pit area after leaching
LA = operational land application area

Table A-4. Soil chemistry data (trace metals) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE
SOIL CHEMISTRY DATA
TRACE ELEMENT SUITE 1

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	ARSENIC (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Cu (mg/kg)	Zn (mg/kg)
** SAMPLE LOCATION : BL								
GMST-3	06/13/86	0	8	0.05 B	2.7	40.3	0.0 N	0.4
GMST4	06/13/86	0	2	1.40	175.0	238.0	0.0 N	1.4
GMST4	06/13/86	2	14	0.93	320.0	241.0	0.0 N	0.3
GMST4	06/13/86	16	20	0.71	240.0	203.0	0.0 N	0.2
GMST5	06/13/86	1	8	0.50	7.9	35.8	0.0 N	0.4
GMST5	06/13/86	8	18	0.92	78.6	89.0	0.0 N	0.5
GMST6	06/13/86	0	4	0.67	8.5	46.5	0.0 N	0.8
GMST6	06/13/86	4	16	0.13	7.7	17.9	0.0 N	0.5
** SAMPLE LOCATION : ES								
EMSPRAY1SW	07/17/86	0	4	0.83	1.3	77.0	0.0 N	0.9
EMSPRAY1SW	07/17/86	4	10	1.26	13.5	184.0	0.0 N	0.3
EMSPRAY2SW	07/17/86	0	4	0.92	2.1	62.0	0.0 N	1.1
EMSPRAY2SW	07/17/86	4	10	0.74	2.5	50.0	0.0 N	0.5
EMSPRAY1NE	07/17/86	0	4	1.20	22.1	225.0	0.0 N	0.8
EMSPRAY1NE	07/17/86	4	10	1.19	48.7	223.0	0.0 N	0.7
EMSPRAY2NE	07/17/86	0	4	1.95	3.0	134.0	0.0 N	2.1
EMSPRAY2NE	07/17/86	4	10	1.55	4.9	123.0	0.0 N	0.5
EMSPRAY1ASW	07/22/86	0	4	0.75	4.2	30.8	0.0 N	0.6
EMSPRAY1ASW	07/22/86	4	10	0.42	4.2	22.6	0.0 N	0.1
EMSPRAY2ASW	07/22/86	0	4	0.72	23.7	125.0	0.0 N	2.8
EMSPRAY2ASW	07/22/86	4	10	0.05 B	36.5	60.5	0.0 N	0.2
** SAMPLE LOCATION : STP								
TP1	08/04/86	0	2	1.92	0.0 N	6.4	0.6	11.9
TP1	08/04/86	2	4	3.20	0.0 N	9.7	0.5	7.7
TP1	08/04/86	4	6	1.96	0.0 N	5.6	0.6	5.3
TP1	08/04/86	6	8	1.27	0.0 N	18.4	0.5	7.5
TP2	08/04/86	0	8	2.04	0.0 N	10.4	0.4	8.6
TP3	08/04/86	0	8	0.25	0.0 N	23.4	0.6	10.7
TP4	08/04/86	0	2	1.25	0.0 N	5.4	0.7	7.7
TP4	08/04/86	2	4	2.04	0.0 N	5.2	0.6	8.1
TP4	08/04/86	4	6	2.02	0.0 N	7.4	0.7	8.9
TP4	08/04/86	6	8	1.06	0.0 N	16.8	0.6	5.5
TP5	08/04/86	0	8	3.42	0.0 N	5.6	0.7	5.4
TP6	08/04/86	0	8	0.79	0.0 N	17.8	0.9	7.0
TP7	08/04/86	0	2	0.20	0.0 N	38.0	0.8	16.9
TP7	08/04/86	2	4	0.17	0.0 N	25.2	0.7	4.5
TP7	08/04/86	4	6	0.15	0.0 N	26.8	0.5	7.6
TP7	08/04/86	6	8	0.12	0.0 N	22.4	0.5	5.5

Table A-4 (continued).

GOLDEN MAPLE / GILT EDGE
SOIL CHEMISTRY DATA
TRACE ELEMENT SUITE 1

** SAMPLE LOCATION : LA

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	ARSENIC (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Cu (mg/kg)	Zn (mg/kg)
1NA	09/09/86	0	4	0.05 B	7.0	84.5	0.0 N	0.8
1NA	09/09/86	4	10	0.09	144.0	99.0	0.0 N	0.8
1NA	09/09/86	10	20	0.23	141.0	110.0	0.0 N	0.6
1NB	09/09/86	4	10	0.11	30.0	110.0	0.0 N	0.6
1NB	09/09/86	10	20	0.14	43.0	106.0	0.0 N	0.6
2NA	09/09/86	0	4	0.06	3.0	43.8	0.0 N	2.1
2NA	09/09/86	4	10	0.18	3.0	22.5	0.0 N	0.5
2NA	09/09/86	10	20	0.05 B	2.0	21.4	0.0 N	0.4
2NB	09/09/86	0	4	0.19	8.0	93.0	0.0 N	1.1
2NB	09/09/86	4	10	0.05 B	12.0	79.0	0.0 N	0.5
2NB	09/09/86	10	20	0.05 B	86.0	132.0	0.0 N	0.3
3NA	09/09/86	0	4	0.05 B	1.0	43.6	0.0 N	3.8
3NA	09/09/86	4	10	0.05 B	6.0	64.0	0.0 N	0.7
3NA	09/09/86	10	20	0.05 B	28.0	95.5	0.0 N	0.9
3NB	09/09/86	0	4	0.27	1.0	24.4	0.0 N	1.3
3NB	09/09/86	4	10	0.05 B	9.0	74.5	0.0 N	0.3
3NB	09/09/86	10	20	0.05 B	73.0	121.0	0.0 N	0.3
4NA	09/09/86	0	4	0.16	5.0	63.0	0.0 N	2.5
4NA	09/09/86	4	10	0.14	8.0	79.0	0.0 N	0.6
4NA	09/09/86	10	20	0.05 B	127.0	185.0	0.0 N	0.4
4NB	09/09/86	0	4	0.26	3.0	94.0	0.0 N	1.6
4NB	09/09/86	4	10	0.05 B	121.0	171.0	0.0 N	0.3
4NB	09/09/86	10	20	0.05	55.0	164.0	0.0 N	0.3
5NA	09/09/86	0	4	0.06	11.0	120.0	0.0 N	0.8
5NA	09/09/86	4	10	0.09	80.0	185.0	0.0 N	0.3
5NA	09/09/86	10	20	0.05 B	156.0	153.0	0.0 N	0.5
5NB	09/09/86	0	4	0.16	2.0	76.0	0.0 N	1.0
5NB	09/09/86	4	10	0.05 B	353.0	441.0	0.0 N	0.5
5NB	09/09/86	10	20	0.05 B	199.0	146.0	0.0 N	0.5

BL = soil test pit area before leaching
ES = emergency process solution spray area
STP= soil test pit area after leaching
LA = operational land application area

Table A-5. Soil chemical data (trace metals) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE
SOIL CHEMISTRY DATA
TRACE ELEMENT SUITE 2

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	Pb (mg/kg)	Ni (mg/kg)	Cd (mg/kg)	Hg (mg/kg)
** SAMPLE LOCATION : BL							
GMST-3	06/13/86	0	8	0.5	0.3	0.1 B	0.05 B
GMST4	06/13/86	0	2	5.2	0.5	0.1	0.08
GMST4	06/13/86	2	14	5.8	1.2	0.2	0.10
GMST4	06/13/86	16	20	7.0	1.4	0.1	0.08
GMST5	06/13/86	1	8	3.2	0.5	0.1 B	0.05 B
GMST5	06/13/86	8	18	3.1	0.9	0.1	0.06
GMST6	06/13/86	0	4	1.2	0.1	0.1 B	0.05 B
GMST6	06/13/86	4	16	1.6	0.2	0.1 B	0.05 B
** SAMPLE LOCATION : ES							
EMSPRAY1SW	07/17/86	0	4	0.4	0.1 B	0.1 B	0.05
EMSPRAY1SW	07/17/86	4	10	0.6	0.5	0.2	0.08
EMSPRAY2SW	07/17/86	0	4	0.4	0.1 B	0.1 B	0.07
EMSPRAY2SW	07/17/86	4	10	0.5	0.1	0.1 B	0.06
EMSPRAY1NE	07/17/86	0	4	0.8	0.3	0.2	0.07
EMSPRAY1NE	07/17/86	4	10	0.9	0.4	0.1	0.06
EMSPRAY2NE	07/17/86	0	4	0.7	0.1 B	0.1	0.10
EMSPRAY2NE	07/17/86	4	10	0.6	0.1 B	0.1 B	0.10
EMSPRAY1ASW	07/22/86	0	4	1.4	0.1	0.1 B	0.05 B
EMSPRAY1ASW	07/22/86	4	10	1.8	0.3	0.1 B	0.05 B
EMSPRAY2ASW	07/22/86	0	4	1.6	0.5	0.2	0.05 B
EMSPRAY2ASW	07/22/86	4	10	3.2	0.5	0.2	0.05 B
** SAMPLE LOCATION : STP							
TP1	08/04/86	0	2	1.4	0.1	0.1 B	0.05 B
TP1	08/04/86	2	4	1.8	0.1	0.1 B	0.05 B
TP1	08/04/86	4	6	1.9	0.2	0.1 B	0.05 B
TP1	08/04/86	6	8	1.9	0.3	0.1 B	0.05 B
TP2	08/04/86	0	8	2.0	0.2	0.1 B	0.05 B
TP3	08/04/86	0	8	3.6	0.2	0.1 B	0.05 B
TP4	08/04/86	0	2	2.1	0.1 B	0.1 B	0.05 B
TP4	08/04/86	2	4	2.1	0.1 B	0.1 B	0.05 B
TP4	08/04/86	4	6	3.1	0.1 B	0.1 B	0.05 B
TP4	08/04/86	6	8	3.6	0.1	0.1 B	0.05 B
TP5	08/04/86	0	8	2.6	0.1 B	0.1 B	0.05 B
TP6	08/04/86	0	8	2.9	0.2	0.1 B	0.05 B
TP7	08/04/86	0	2	5.7	0.5	0.1 B	0.05 B
TP7	08/04/86	2	4	3.2	0.2	0.1 B	0.05 B
TP7	08/04/86	4	6	3.7	0.2	0.1 B	0.05 B
TP7	08/04/86	6	8	3.2	0.2	0.1 B	0.05 B

Table A-5 (Continued).

GOLDEN MAPLE / GILT EDGE
SOIL CHEMISTRY DATA
TRACE ELEMENT SUITE 2

STATION	DATE	TOP DEPTH (IN)	BOTTOM DEPTH (IN)	Pb (mg/kg)	Ni (mg/kg)	Cd (mg/kg)	Hg (mg/kg)
** SAMPLE LOCATION : LA							
1NA	09/09/86	0	4	0.1 B	0.1	0.1 B	0.05 B
1NA	09/09/86	4	10	0.3	0.5	0.2	0.05 B
1NA	09/09/86	10	20	0.4	0.5	0.2	0.05 B
1NB	09/09/86	4	10	0.3	0.4	0.2	0.05 B
1NB	09/09/86	10	20	0.3	0.4	0.2	0.05 B
2NA	09/09/86	0	4	0.1 B	0.1 B	0.1 B	0.05 B
2NA	09/09/86	4	10	0.1 B	0.3	0.1 B	0.05 B
2NA	09/09/86	10	20	0.1 B	0.3	0.1 B	0.05 B
2NB	09/09/86	0	4	0.2	0.1	0.1	0.05 B
2NB	09/09/86	4	10	0.2	0.3	0.1 B	0.05 B
2NB	09/09/86	10	20	0.1 B	0.7	0.1	0.05 B
3NA	09/09/86	0	4	0.1 B	0.1 B	0.1 B	0.05 B
3NA	09/09/86	4	10	0.1 B	0.3	0.1 B	0.05 B
3NA	09/09/86	10	20	0.1	0.3	0.1	0.05 B
3NB	09/09/86	0	4	0.1 B	0.1 B	0.1 B	0.05 B
3NB	09/09/86	4	10	0.1 B	0.2	0.1 B	0.05 B
3NB	09/09/86	10	20	0.1	0.3	0.1	0.05 B
4NA	09/09/86	0	4	0.1 B	0.1 B	0.1 B	0.05 B
4NA	09/09/86	4	10	0.1	0.2	0.1 B	0.05 B
4NA	09/09/86	10	20	0.2	0.5	0.1	0.05 B
4NB	09/09/86	0	4	0.1 B	0.1 B	0.1 B	0.05 B
4NB	09/09/86	4	10	0.1	0.4	0.1 B	0.05 B
4NB	09/09/86	10	20	0.1 B	0.3	0.1 B	0.05 B
5NA	09/09/86	0	4	0.1 B	0.2	0.1 B	0.05 B
5NA	09/09/86	4	10	0.3	0.6	0.2	0.05 B
5NA	09/09/86	10	20	0.3	0.7	0.2	0.05 B
5NB	09/09/86	0	4	0.1 B	0.1	0.1 B	0.05 B
5NB	09/09/86	4	10	0.6	0.8	0.2	0.05 B

BL = soil test pit area before leaching
ES = emergency process solution spray area
STP= soil test pit area after leaching
LA = operational land application area

APPENDIX B
GROUND WATER CHEMISTRY DATA
GOLDEN MAPLE GILT EDGE MINE

GROUND WATER MONITORING DATA

Table B-1. Ground Water quality data from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
MAJOR CATIONS

DATE	pH	EC (micro-mhos/cm)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	SAR	Cl (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)
** Sample Station: BGD									
05/28/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N
12/17/86	6.9	1040	88.00	65.00	2.00	1.00	4.00	0.00 N	0.0 N
04/07/87	7.2	798	0.00 N	0.00 N	0.00 N	0.01	0.00	0.00 N	0.0 N
** Sample Station: DDS									
05/17/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/12/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/01/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/09/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/18/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/23/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
09/23/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
10/30/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
10/31/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
11/16/85	0.0	0	0.00 N	0.00 N	1.00	0.00	0.00	0.00 N	0.0 N
01/13/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N
02/23/86	0.0	0	0.00 N	0.00 N	2.00	0.00	0.00	0.00 N	0.0 N
03/28/86	0.0	0	0.00 N	0.00 N	1.00	0.00	0.00	0.89	0.1 B
12/05/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N
12/18/86	7.1	960	117.00	32.00	1.00 B	1.00	14.00	0.00 N	0.0 N
04/07/87	7.1	688	0.00 N	0.00 N	0.00 N	0.01	0.00	0.00 N	0.0 N
05/01/87	7.4	643	0.00 N	0.00 N	0.00 N	0.00	1.00	0.00 N	0.0 N
** Sample Station: DSP1									
12/18/86	7.3	1080	104.00	58.00	1.00 B	1.00	9.00	0.00 N	0.0 N
04/07/87	7.0	849	0.00 N	0.00 N	0.00 N	0.01	0.00	0.00 N	0.0 N
05/01/87	7.3	815	26.00	58.00	2.00	0.06	1.00	0.00 N	0.0 N
** Sample Station: DSP2									
12/18/86	7.2	1220	150.00	44.00	9.00	1.00	5.00	0.00 N	0.0 N
04/07/87	7.0	895	0.00 N	0.00 N	0.00 N	0.11	0.00	0.00 N	0.0 N
05/01/87	7.1	912	82.00	49.00	11.00	0.25	2.00	0.00 N	0.0 N
** Sample Station: DSP3									
12/18/86	7.3	1070	129.00	36.00	3.00	1.00	13.00	0.00 N	0.0 N
04/07/87	7.2	848	0.00 N	0.00 N	0.00 N	0.04	0.00	0.00 N	0.0 N
05/01/87	7.4	783	64.00	37.00	5.00	0.12	6.00	0.00 N	0.0 N

Table B-1 (continued).

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
MAJOR CATIONS

DATE	pH	EC (micro-mhos/cm)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	SAR	Cl (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)
** Sample Station: DSS									
05/17/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/12/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/01/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
08/29/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
11/16/85	0.0	0	0.00 N	0.00 N	2.00	0.00	0.00	0.00 N	0.0 N
01/13/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N
02/23/86	0.0	0	0.00 N	0.00 N	3.00	0.00	0.00	0.00 N	0.0 N
03/28/86	0.0	0	0.00 N	0.00 N	2.00	0.00	0.00	0.00 N	0.0 N
12/05/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N
12/18/86	6.9	1130	138.00	37.00	1.00	1.00	9.00	0.00 N	0.0 N
04/07/87	7.1	836	0.00 N	0.00 N	0.00 N	0.08	0.00	0.00 N	0.0 N
05/01/87	7.4	834	68.00	37.00	4.00	0.09	1.00	0.00 N	0.0 N
** Sample Station: PW									
05/17/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/12/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/09/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/18/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
07/23/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
12/17/86	6.9	1400	152.00	52.00	27.00	1.00	14.00	0.00 N	0.0 N
04/07/87	6.9	129	0.00 N	0.00 N	0.00 N	0.50	0.00	0.00 N	0.0 N

N = no data
B = below instrument detection limit
BGD = backround ground water quality
DDS = Dufy's domestic Spring
DSP1= well DSP 1
DSP2= well DSP 2
DSP3= well DSP 3
DSS = Duffy's stock spring
PW = Production well (below process ponds)

Table B-2. Ground water chemistry data (cyanide) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
CYANIDE & TRACE METALS

Date	Cyanide Total (mg/l)	Cyanide Chlorine Amenable (mg/l)	Cyanide Weak Acid Dissociable (mg/l)	As (mg/l)	Hg (mg/l)	Pb (mg/l)
** Sample Station: BGD						
05/28/86	0.005 B	0.005 B	0.000 N	0.005 B	0.0010 B	0.000 N
12/17/86	0.013	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.007	0.005 B	0.000 N	0.043	0.0010 B	0.010 B
** Sample Station: DDS						
05/17/85	0.000 N	0.015	0.000 N	0.000 N	0.0000 N	0.000 N
06/07/85	0.009	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
06/12/85	0.009	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
07/01/85	0.010	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
07/09/85	0.018	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
07/18/85	0.022	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
07/23/85	0.024	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
09/23/85	0.017	0.005	0.000 N	0.000 N	0.0000 N	0.000 N
10/30/85	0.119	0.014	0.000 N	0.000 N	0.0000 N	0.000 N
10/31/85	0.050	0.012	0.000 N	0.000 N	0.0000 N	0.000 N
11/16/85	0.055	0.000 N	0.046	0.005 B	0.0010 B	0.000 N
01/13/86	0.053	0.000 N	0.009	0.005 B	0.0010 B	0.000 N
02/23/86	0.034	0.000 N	0.008	0.005 B	0.0010 B	0.000 N
03/28/86	0.025	0.000 N	0.010	0.005 B	0.0010 B	0.000 N
12/05/86	0.054	0.000 N	0.005	0.005 B	0.0010 B	0.000 N
12/18/86	0.067	0.006	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.029	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
05/01/87	0.022	0.005 B	0.000 N	0.005 B	0.0000 N	0.000 N
** Sample Station: DSP1						
12/18/86	0.005 B	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.005 B	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
05/01/87	0.022	0.005 B	0.000 N	0.005 B	0.0000 N	0.010 B
** Sample Station: DSP2						
12/18/86	0.126	0.014	0.000 N	0.013	0.0010 B	0.010 B
04/07/87	0.096	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
05/01/87	0.164	0.005 B	0.000 N	0.005 B	0.0000 N	0.010 B
** Sample Station: DSP3						
12/18/86	0.013	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.010	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
05/01/87	0.011	0.005 B	0.000 N	0.005 B	0.0000 N	0.010 B

Table B-2 (continued).

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
CYANIDE & TRACE METALS

Date	Cyanide Total (mg/l)	Cyanide Chlorine Amenable (mg/l)	Cyanide Weak Acid Dissociable (mg/l)	As (mg/l)	Hg (mg/l)	Pb (mg/l)
** Sample Station: DSS						
05/17/85	0.000 N	0.021	0.000 N	0.000 N	0.0000 N	0.000 N
06/07/85	0.019	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
06/12/85	0.017	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
07/01/85	0.016	0.006	0.000 N	0.000 N	0.0000 N	0.000 N
08/29/85	0.043	0.005	0.000 N	0.000 N	0.0000 N	0.000 N
11/16/85	0.111	0.000 N	0.098	0.005 B	0.0010 B	0.000 N
01/13/86	0.125	0.000 N	0.014	0.005 B	0.0010 B	0.000 N
02/23/86	0.068	0.000 N	0.012	0.023	0.0010 B	0.000 N
03/28/86	0.123	0.000 N	0.030	0.013	0.0010 B	0.000 N
12/05/86	0.112	0.000 N	0.009	0.005 B	0.0010 B	0.000 N
12/18/86	0.137	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.124	0.015	0.000 N	0.005 B	0.0010 B	0.010 B
05/01/87	0.101	0.005 B	0.000 N	0.005 B	0.0000 N	0.010 B
** Sample Station: PW						
05/17/85	0.000 N	0.140	0.000 N	0.000 N	0.0000 N	0.000 N
06/07/85	1.140	0.880	0.000 N	0.000 N	0.0000 N	0.000 N
06/12/85	1.450	0.912	0.000 N	0.000 N	0.0000 N	0.000 N
07/09/85	0.410	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
07/18/85	0.330	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
07/23/85	0.180	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N
12/17/86	0.183	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B
04/07/87	0.320	0.005 B	0.000 N	0.005 B	0.0010 B	0.010 B

N = no data
B = below instrument detection limit
BGD = backround ground water quality
DDS = Dufy's domestic Spring
DSP1= well DSP 1
DSP2= well DSP 2
DSP3= well DSP 3
DSS = Duffy's stock spring
PW = Production well (below process ponds)

Table B-3. Ground water quality data (trace metals) from the Golden Maple Gilt Edge Mi

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
TRACE ELEMENTS

Date	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Zn (mg/l)
** Sample Station: BGD						
05/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N
12/17/86	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
04/07/87	0.005	0.000 N	0.010 B	0.000 N	0.000 N	0.100
** Sample Station: DDS						
05/17/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/12/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/01/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/09/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/18/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/23/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
09/23/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
10/30/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
10/31/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
11/16/85	0.001 B	0.000 N	0.000 N	0.000 N	0.030 B	0.010 B
01/13/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
02/23/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
12/05/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
12/18/86	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.010
05/01/87	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
** Sample Station: DSP1						
12/18/86	0.003	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.020
05/01/87	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
** Sample Station: DSP2						
12/18/86	0.001 B	0.000 N	0.030	0.000 N	0.030 B	0.010 B
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.130
05/01/87	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
** Sample Station: DSP3						
12/18/86	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.020
05/01/87	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B

Table B-3. (continued).

GOLDEN MAPLE / GILT EDGE MINE
GROUND WATER QUALITY DATA
TRACE ELEMENTS

Date	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Zn (mg/l)
** Sample Station: DSS						
05/17/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/12/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/01/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/09/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
08/29/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
01/13/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
02/23/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
12/05/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
12/18/86	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.020
05/01/87	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
** Sample Station: PW						
05/17/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/12/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/09/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/18/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
07/23/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
12/17/86	0.003	0.000 N	0.020	0.000 N	0.030 B	0.020
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.050

N = no data
B = below instrument detection limit
BGD = backround ground water quality
DDS = Dufy's domestic Spring
DSP1= well DSP 1
DSP2= well DSP 2
DSP3= well DSP 3
DSS = Duffy's stock spring
PW = Production well (below process ponds)

APPENDIX C

SURFACE WATER CHEMISTRY DATA
GOLDEN MAPLE GILT EDGE MINE

SURFACE WATER MONITORING DATA

Table C-1. Surface water chemistry data (major cations) from the Golden Maple Gilt Edge

GOLDEN MAPLE / GILT EDGE MINE
SURFACE WATER QUALITY DATA
MAJOR CATIONS

DATE	pH	EC (micro-mhos/cm)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	SAR	Cl (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)
** Sample Station: CHIP. CR.									
07/01/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
04/07/87	7.6	647	0.00 N	0.00 N	0.00 N	0.03	0.00	0.00 N	0.0 N
** Sample Station: DD									
03/28/86	0.0	0	0.00 N	0.00 N	174.00	0.00	0.00	0.00 N	0.0 N
** Sample Station: EP									
05/12/86	0.0	0	0.00 N	0.00 N	282.00	0.00	0.00	0.00 N	0.0 N
** Sample Station: GMCR									
05/01/87	7.6	650	58.00	37.00	0.05	0.13	8.00	0.00 N	0.0 N
** Sample Station: N. HILL RO									
10/30/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
** Sample Station: OD									
05/28/86	0.0	0	0.00 N	0.00 N	354.00	0.00	0.00	0.00 N	0.0 N
** Sample Station: PR									
04/07/87	7.6	118	0.00 N	0.00 N	0.00 N	0.01	0.00	0.00 N	0.0 N
** Sample Station: SW2									
05/17/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
** Sample Station: SW3									
05/17/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
06/12/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
** Sample Station: TRIAD SW1									
12/16/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N
** Sample Station: UPPER TAIL									
04/07/87	7.4	154	0.00 N	0.00 N	0.00 N	0.01	0.00	0.00 N	0.0 N
** Sample Station: WASTE PILE									

N = no data
B = below instrument detection limits
see text for location of surface water stations

Table C-2. Surface water chemistry data (cyanide) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
SURFACE WATER QUALITY DATA
CYANIDE & TRACE METALS

Date	Cyanide Total (mg/l)	Cyanide Chlorine Amenable (mg/l)	Cyanide Weak Acid Dissociable (mg/l)	As (mg/l)	Hg (mg/l)	Pb (mg/l)
** Sample Station: CHIP. CR.						
07/01/85	0.000 N	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
04/07/87	0.009	0.005 B	0.000 N	0.027	0.0010 B	0.010 B
** Sample Station: DD						
03/28/86	30.000	0.000 N	17.600	2.400	1.1300	0.000 N
** Sample Station: EP						
05/12/86	11.300	9.830	0.000 N	0.057	0.0030	0.000 N
** Sample Station: GMCR						
05/01/87	0.010	0.005 B	0.000 N	0.020	0.0000 N	0.010 B
** Sample Station: N. HILL RO						
10/30/85	40.000	0.000 N	37.000	0.000 N	0.0000 N	0.000 N
** Sample Station: OD						
05/28/86	15.200	4.200	0.000 N	0.100	0.0020	0.000 N
** Sample Station: PR						
04/07/87	0.019	0.005 B	0.000 N	0.396	0.0010 B	0.010 B
** Sample Station: SW2						
05/17/85	0.000 N	0.005	0.000 N	0.000 N	0.0000 N	0.000 N
** Sample Station: SW3						
05/17/85	0.000 N	0.005	0.000 N	0.000 N	0.0000 N	0.000 N
06/07/85	0.005 B	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
06/12/85	0.007	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N
** Sample Station: TRIAD SW1						
12/16/86	0.013	0.000 N	0.000 N	0.042	0.0010 B	0.010 B
** Sample Station: UPPER TAIL						
04/07/87	0.038	0.005 B	0.000 N	1.750	0.0010 B	0.020
** Sample Station: WASTE PILE						

N = no data
B = below instrument detection limits
see text for location of surface water stations

Table C-3. Surface water chemistry data (trace metals) from the Golden Maple Gilt Edge

GOLDEN MAPLE / GILT EDGE MINE
SURFACE WATER QUALITY DATA
TRACE ELEMENTS

Date	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Zn (mg/l)
** Sample Station: CHIP. CR.						
07/01/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
04/07/87	0.001 B	0.000 N	0.010 B	0.000 N	0.000 N	0.010 B
** Sample Station: DD						
03/28/86	0.000 N	0.000 N	0.360	0.000 N	0.000 N	0.000 N
** Sample Station: EP						
05/12/86	0.000 N	0.000 N	0.000 N	0.000 N	0.510	0.000 N
** Sample Station: GMCR						
05/01/87	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.010 B
** Sample Station: N. HILL RO						
10/30/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
** Sample Station: OD						
05/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.040	0.000 N
** Sample Station: PR						
04/07/87	0.005	0.000 N	0.010 B	0.000 N	0.000 N	0.070
** Sample Station: SW2						
05/17/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
** Sample Station: SW3						
05/17/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
06/12/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N
** Sample Station: TRIAD SW1						
12/16/86	0.001 B	0.000 N	0.010 B	0.000 N	0.030 B	0.040
** Sample Station: UPPER TAIL						
04/07/87	0.016	0.000 N	0.010 B	0.000 N	0.000 N	0.290
** Sample Station: WASTE PILE						

N = no data
B = below instrument detection limits
see text for location of surface water stations

APPENDIX D

PROCESS SOLUTION CHEMISTRY DATA
GOLDEN MAPLE GILT EDGE MINE

PROCESS SOLUTION MONITORING DATA

Table D-1. Process solution water chemistry data (major cations) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
MAJOR CATIONS

DATE	pH	EC (micro-mhos/cm)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	SAR	Cl (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)	NAME
** Sample Station: EP										
06/12/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	EP
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	EP
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	EP
11/07/85	0.0	0	0.00 N	0.00 N	404.00	0.00	0.00	0.00 N	0.0 N	EP
12/16/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	EP BOTTOM
12/16/85	0.0	3079	0.00 N	0.00 N	470.00	0.00	193.00	0.00 N	0.0 N	EP SURFACE
03/28/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	EP
10/02/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	P4
** Sample Station: IRR										
10/04/86	7.8	2060	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM1
10/04/86	7.6	1660	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM2
10/04/86	7.6	1660	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM6
10/04/86	7.8	2060	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM7
10/06/86	7.4	2340	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM3
10/06/86	7.4	2340	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	GM5
** Sample Station: LJ										
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	LJ
11/07/85	7.6	2670	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	LJ
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	LJ A
11/07/85	0.0	0	0.00 N	0.00 N	406.00	0.00	0.00	0.00 N	0.0 N	LJ B
09/05/86	7.6	2800	368.00	18.00	352.00	4.85	82.00	0.00 N	0.0 N	LJ
** Sample Station: PP1										
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP1
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP1A
11/07/85	0.0	0	0.00 N	0.00 N	357.00	0.00	0.00	0.00 N	0.0 N	PP1B
12/16/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP1BOTTOM
12/16/85	0.0	2720	0.00 N	0.00 N	440.00	0.00	175.00	0.00 N	0.0 N	PP1SURFACE
03/28/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP1
10/01/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	P1
** Sample Station: PP2										
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP2
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP2A
11/07/85	0.0	0	0.00 N	0.00 N	403.00	0.00	0.00	0.00 N	0.0 N	PP2B
12/16/85	0.0	3328	0.00 N	0.00 N	532.00	0.00	70.00	0.00 N	0.0 N	PP2
12/16/85	0.0	0	0.00 N	0.00 N	504.00	0.00	0.00	0.00 N	0.0 N	PP2
03/28/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	PP2

Table D-1. (continued).

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
MAJOR CATIONS

DATE	pH	EC (micro-mhos/cm)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	SAR	Cl (mg/l)	NO3-N (mg/l)	NH4-N (mg/l)	NAME
09/26/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	P2
10/02/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	P2
** Sample Station: PP3										
11/07/85	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	BP A
11/07/85	0.0	0	0.00 N	0.00 N	413.00	0.00	0.00	0.00 N	0.0 N	BP B
12/16/85	0.0	0	0.00 N	0.00 N	503.00	0.00	0.00	0.00 N	0.0 N	BP
12/16/85	0.0	3357	0.00 N	0.00 N	542.00	0.00	55.00	0.00 N	0.0 N	BP3
03/28/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	BP
10/02/86	0.0	0	0.00 N	0.00 N	0.00 N	0.00	0.00	0.00 N	0.0 N	P3
** Sample Station: STP										
04/30/86	0.0	0	0.00 N	0.00 N	25.00	0.00	0.00	0.00 N	0.0 N	ST2 FB
04/30/86	0.0	0	0.00 N	0.00 N	29.00	0.00	0.00	0.00 N	0.0 N	ST2 IB
04/30/86	0.0	0	0.00 N	0.00 N	215.00	0.00	0.00	0.00 N	0.0 N	ST2 OB
04/30/86	0.0	0	0.00 N	0.00 N	13.00	0.00	0.00	0.00 N	0.0 N	ST3 FB
04/30/86	0.0	0	0.00 N	0.00 N	54.00	0.00	0.00	0.00 N	0.0 N	ST3 IB
04/30/86	0.0	0	0.00 N	0.00 N	246.00	0.00	0.00	0.00 N	0.0 N	ST3 OB
04/30/86	0.0	0	0.00 N	0.00 N	57.00	0.00	0.00	0.00 N	0.0 N	ST4 FL
04/30/86	0.0	0	0.00 N	0.00 N	38.00	0.00	0.00	0.00 N	0.0 N	ST4 L2FB
04/30/86	0.0	0	0.00 N	0.00 N	59.00	0.00	0.00	0.00 N	0.0 N	ST4 L2IB
04/30/86	0.0	0	0.00 N	0.00 N	209.00	0.00	0.00	0.00 N	0.0 N	ST4 OB
05/01/86	0.0	0	0.00 N	0.00 N	15.00	0.00	0.00	0.00 N	0.0 N	ST5 FL
05/01/86	0.0	0	0.00 N	0.00 N	23.00	0.00	0.00	0.00 N	0.0 N	ST5 IL
05/01/86	0.0	0	0.00 N	0.00 N	225.00	0.00	0.00	0.00 N	0.0 N	ST5 OB
05/01/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N	ST6 FB
05/01/86	0.0	0	0.00 N	0.00 N	1.00 B	0.00	0.00	0.00 N	0.0 N	ST6 IB

N = no data
B = below instrument detection limit
EP = emergency pond
IRR = irrigated process solution
LJ = "Lake Jones" process solution irrigation holding pond
PP1 = pregnant pond 1
PP2 = pregnant pond 2
PP3 = barren pond
STP = soil test pit leachant(OB) & leachate (IB, IL, FB, FL)

Table D-2. Process solution water chemistry (cyanide) from the Golden Maple Gilt Edge Mine

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
CYANIDE & TRACE METALS

Date	Cyanide Total (mg/l)	Cyanide Chlorine Amenable (mg/l)	Cyanide Weak Acid Dissociable (mg/l)	As (mg/l)	Hg (mg/l)	Pb (mg/l)	NAME
** Sample Station: EP							
06/12/85	31.600	28.000	0.000 N	0.000 N	0.0000 N	0.000 N	EP
11/07/85	38.000	0.000 N	34.000	0.000 N	0.0000 N	0.000 N	EP
11/07/85	0.000 N	0.000 N	0.000 N	0.080	0.1270	0.000 N	EP
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.010 B	EP
12/16/85	0.000 N	0.000 N	0.000 N	0.053	0.0002 B	0.000 N	EP BOTTOM
12/16/85	12.000	0.000 N	0.000 N	0.053	0.0002 B	0.000 N	EP SURFACE
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N	EP
10/02/86	0.043	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N	P4
** Sample Station: IRR							
10/04/86	0.825	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N	GM1
10/04/86	0.456	0.006	0.000 N	0.000 N	0.0000 N	0.000 N	GM2
10/04/86	0.456	0.006	0.000 N	0.000 N	0.0000 N	0.000 N	GM6
10/04/86	0.825	0.005 B	0.000 N	0.000 N	0.0000 N	0.000 N	GM7
10/06/86	0.633	0.027	0.000 N	0.000 N	0.0000 N	0.000 N	GM3
10/06/86	0.633	0.027	0.000 N	0.000 N	0.0000 N	0.000 N	GM5
** Sample Station: LJ							
11/07/85	36.000	0.000 N	32.000	0.000 N	0.0000 N	0.000 N	LJ
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N	LJ
11/07/85	0.000 N	0.000 N	0.000 N	0.070	0.0730	0.000 N	LJ A
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.010 B	LJ B
09/05/86	0.460	0.005 B	0.000 N	0.135	0.0160	0.010 B	LJ
** Sample Station: PP1							
11/07/85	50.000	0.000 N	27.000	0.000 N	0.0000 N	0.000 N	PP1
11/07/85	0.000 N	0.000 N	0.000 N	0.400	0.6950	0.000 N	PP1A
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.010 B	PP1B
12/16/85	0.000 N	0.000 N	0.000 N	0.568	0.0002 B	0.000 N	PP1BOTTOM
12/16/85	41.000	0.000 N	0.000 N	0.560	0.0002 B	0.000 N	PP1SURFACE
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N	PP1
10/01/86	1.850	0.957	0.000 N	0.350	0.0550	0.010 B	P1
** Sample Station: PP2							
11/07/85	40.000	0.000 N	35.000	0.000 N	0.0000 N	0.000 N	PP2
11/07/85	0.000 N	0.000 N	0.000 N	0.210	0.1560	0.000 N	PP2A
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.030	PP2B
12/16/85	15.700	0.000 N	0.000 N	0.220	0.0002 B	0.000 N	PP2
12/16/85	44.000	0.000 N	38.000	0.267	0.0100	0.000 N	PP2
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N	PP2

Table D-2. (continued).

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
CYANIDE & TRACE METALS

Date	Cyanide Total (mg/l)	Cyanide Chlorine Amenable (mg/l)	Cyanide Weak Acid Dissociable (mg/l)	As (mg/l)	Hg (mg/l)	Pb (mg/l)	NAME
09/26/86	3.160	1.080	0.000 N	0.114	0.0230	0.000 N	P2
10/02/86	3.600	1.420	0.000 N	0.000 N	0.0000 N	0.000 N	P2
** Sample Station: PP3							
11/07/85	0.000 N	0.000 N	0.000 N	0.150	0.0760	0.000 N	BP A
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.010 B	BP B
12/16/85	46.000	0.000 N	41.000	0.153	0.0070	0.000 N	BP
12/16/85	13.200	0.000 N	0.000 N	0.174	0.0002 B	0.000 N	BP3
03/28/86	0.000 N	0.000 N	0.000 N	0.000 N	0.0000 N	0.000 N	BP
10/02/86	1.190	0.627	0.000 N	0.000 N	0.0000 N	0.000 N	P3
** Sample Station: STP							
04/30/86	0.252	0.021	0.000 N	0.025	0.0010 B	0.000 N	ST2 FB
04/30/86	0.440	0.005 B	0.000 N	0.030	0.0010 B	0.000 N	ST2 IB
04/30/86	0.330	0.005 B	0.000 N	0.035	0.0680	0.000 N	ST2 OB
04/30/86	0.255	0.057	0.000 N	0.005 B	0.0010 B	0.000 N	ST3 FB
04/30/86	0.234	0.044	0.000 N	0.005	0.0020	0.000 N	ST3 IB
04/30/86	0.451	0.005 B	0.000 N	0.032	0.0710	0.000 N	ST3 OB
04/30/86	0.374	0.068	0.000 N	0.007	0.0010	0.000 N	ST4 FL
04/30/86	0.000 N	0.000 N	0.000 N	0.005	0.0020	0.000 N	ST4 L2FB
04/30/86	0.294	0.005 B	0.000 N	0.015	0.0010 B	0.000 N	ST4 L2IB
04/30/86	0.294	0.005 B	0.000 N	0.035	0.0680	0.000 N	ST4 OB
05/01/86	0.159	0.026	0.000 N	0.007	0.0010 B	0.000 N	ST5 FL
05/01/86	0.156	0.011	0.000 N	0.007	0.0010	0.000 N	ST5 IL
05/01/86	0.237	0.012	0.000 N	0.035	0.0710	0.000 N	ST5 OB
05/01/86	0.200	0.052	0.000 N	0.005 B	0.0010 B	0.000 N	ST6 FB
05/01/86	0.132	0.037	0.000 N	0.007	0.0010 B	0.000 N	ST6 IB

N = no data
B = below instrument detection limit
EP = emergency pond
IRR = irrigated process solution
LJ = "Lake Jones" process solution irrigation holding pond
PP1 = pregnant pond 1
PP2 = pregnant pond 2
PP3 = barren pond
STP = soil test pit leachant(OB) & leachate (IB, IL, FB, FL)

Table D-3. Process solution water chemistry data (trace metals) from the Golden Maple Gilt Edge Mine.

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
TRACE ELEMENTS

Date	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Zn (mg/l)	NAME
** Sample Station: EP							
06/12/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	EP
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	EP
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	EP
11/07/85	0.002	0.000 N	0.000 N	1.590	0.660	0.030	EP
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	EP BOTTOM
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	EP SURFACE
03/28/86	0.000 N	0.000 N	0.050	0.000 N	0.000 N	0.000 N	EP
10/02/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	P4
** Sample Station: IRR							
10/04/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM1
10/04/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM2
10/04/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM6
10/04/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM7
10/06/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM3
10/06/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	GM5
** Sample Station: LJ							
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	LJ
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	LJ
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	LJ A
11/07/85	0.002	0.000 N	0.000 N	1.080	0.730	0.020	LJ B
09/05/86	0.004	0.000 N	0.060	0.000 N	0.130	0.020	LJ
** Sample Station: PP1							
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP1
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP1A
11/07/85	0.028	0.000 N	0.000 N	1.520	1.090	6.530	PP1B
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP1BOTTOM
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP1SURFACE
03/28/86	0.000 N	0.000 N	0.080	0.000 N	0.000 N	0.000 N	PP1
10/01/86	0.029	0.020 B	0.000 N	0.000 N	0.000 N	0.210	P1
** Sample Station: PP2							
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP2
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP2A
11/07/85	0.005	0.000 N	0.000 N	1.300	0.750	0.050	PP2B
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP2
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	PP2
03/28/86	0.000 N	0.000 N	0.020	0.000 N	0.000 N	0.000 N	PP2
09/26/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.040	P2

Table D-3. (continued).

GOLDEN MAPLE / GILT EDGE MINE
PROCESS SOLUTION WATER QUALITY DATA
TRACE ELEMENTS

Date	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Zn (mg/l)	NAME
10/02/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	P2
** Sample Station: PP3							
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	BP
11/07/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	BP A
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	BP
12/16/85	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	BP3
03/28/86	0.000 N	0.000 N	0.030	0.000 N	0.000 N	0.000 N	BP
10/02/86	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	0.000 N	P3
** Sample Station: STP							
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST2 FB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030	0.000 N	ST2 IB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.160	0.000 N	ST2 OB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST3 FB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST3 IB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.160	0.000 N	ST3 OB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST4 FL
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST4 L2FB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST4 L2IB
04/30/86	0.000 N	0.000 N	0.000 N	0.000 N	0.160	0.000 N	ST4 OB
05/01/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST5 FL
05/01/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST5 IL
05/01/86	0.000 N	0.000 N	0.000 N	0.000 N	0.016	0.000 N	ST5 OB
05/01/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST6 FB
05/01/86	0.000 N	0.000 N	0.000 N	0.000 N	0.030 B	0.000 N	ST6 IB

N = no data
B = below instrument detection limit
EP = emergency pond
IRR = irrigated process solution
LJ = "Lake Jones" process solution irrigation holding pond
PP1 = pregnant pond 1
PP2 = pregnant pond 2
PP3 = barren pond
STP = soil test pit leachant(OB) & leachate (IB, IL, FB, FL)

APPENDIX E

COMPLETION DIAGRAMS FOR GROUND WATER MONITORING WELLS

Schafer & Associates
P.O. Box 6186
Bozeman, MT 59715
(406) 587-3478

Waste Management
Land Reclamation
Resource Inventory
Agricultural Consulting

LYSIMETER/WELL INSTALLATION REPORT

LOCATION: BGD-1

****

CLIENT : MDSL
JOB NAME : GOLDEN MAPLE
DATE DRILLED: ___/___/___
COUNTY :
LEGAL :
DATE INSTALLED: ___/___/___

DRILLING:

****

METHOD :
DRILLER :
HOLE DEPTH : 102
HOLE DIAMETER : 4" PVC CASING

DRILLING LOG

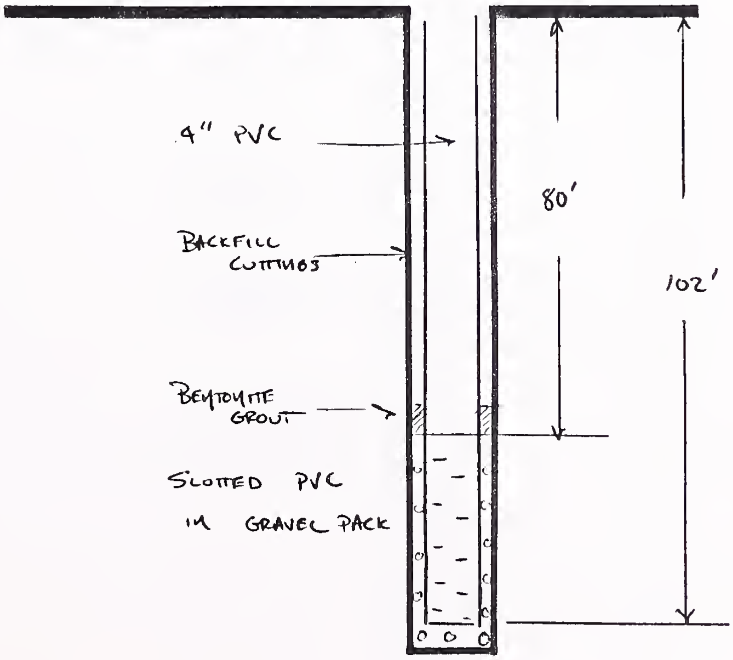
DEPTH INTERVAL			DESCRIPTION
0	to	8	TAILINGS
8	to	15	OLD TOPSOIL, ALLUVIUM
15	to	102	BEDROCK, SHALE, HIGH CLAY FRACTION
	to		
	to		
	to		
	to		
	to		

INSTALLATION:

****

LYS/SCREEN/PERF TYPE : SLOTTED PVC
LYS PREPARATION :
MULTIPLE LYSIMETERS :
BOTTOM GROUT TYPE/DEPTH:
TOP GROUT TYPE/DEPTH : BENTONITE, 80
PACK TYPE/DEPTH : GRAVEL 80-102
BOTTOM LYS/SCREEN : 102
TOP LYS/SCREEN : 80
BACKFILL TYPE/METHOD : CUTTINGS

INSTALLATION DIAGRAM



NOTES:

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Agricultural Consulting

LYSIMETER/WELL INSTALLATION REPORT

LOCATION: BGD-2

****

CLIENT : MDSL
JOB NAME : Golden Maple
DATE DRILLED: ___/___/___
COUNTY :
LEGAL :
DATE INSTALLED: ___/___/___

DRILLING:

****

METHOD :
DRILLER :
HOLE DEPTH : 60'
HOLE DIAMETER : 4" PVC Casing

DRILLING LOG

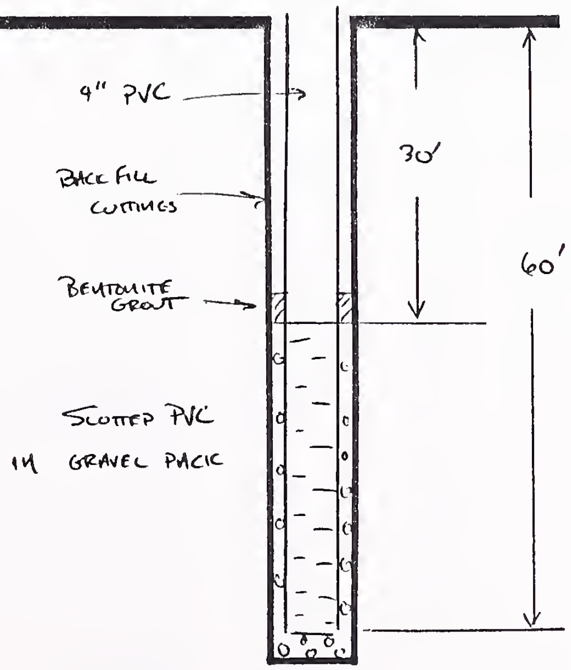
DEPTH INTERVAL			DESCRIPTION
0	to	8	Tailings
8	to	15	Old topsoil, Alluvium
15	to	60	Bedrock, Shale, High clay fraction
	to		
	to		
	to		
	to		
	to		

INSTALLATION:

****

LYS/SCREEN/PERF TYPE : Slotted PVC
LYS PREPARATION :
MULTIPLE LYSIMETERS :
BOTTOM GROUT TYPE/DEPTH:
TOP GROUT TYPE/DEPTH : Bentonite 30
PACK TYPE/DEPTH : Gravel 30-60
BOTTOM LYS/SCREEN : 60
TOP LYS/SCREEN : 30
BACKFILL TYPE/METHOD : Cuttings

INSTALLATION DIAGRAM



NOTES:

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LYSIMETER/WELL INSTALLATION REPORT

LOCATION: PRODUCTION WELL

****

CLIENT : MDSL
JOB NAME : GOLDEN MAPLE
DATE DRILLED: ___/___/___
COUNTY :
LEGAL :
DATE INSTALLED: ___/___/___

DRILLING:

****

METHOD :
DRILLER :
HOLE DEPTH : 72'
HOLE DIAMETER : 6" STEEL CASING 0-20'
4" PVC CASING 20-72'

DRILLING LOG

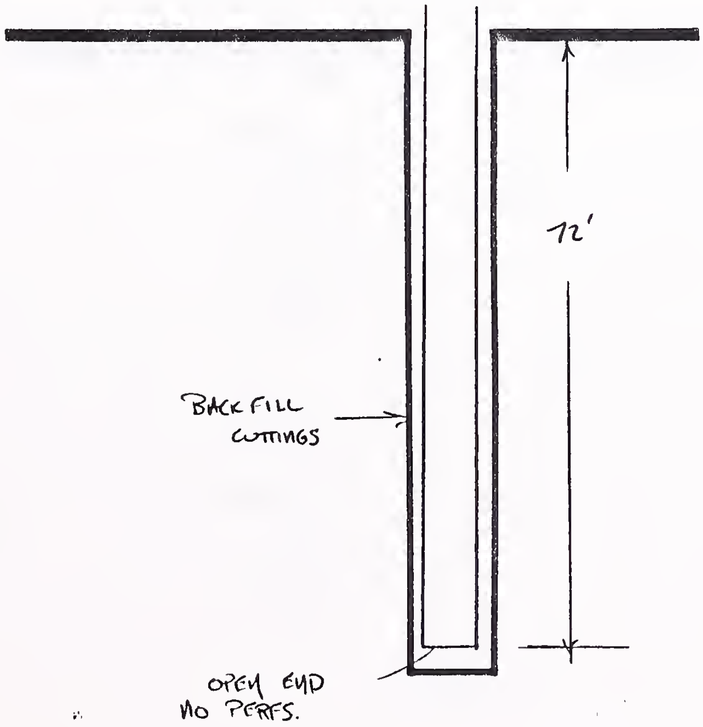
DEPTH INTERVAL			DESCRIPTION
0	to	8	TAILINGS
8	to	15	OLD TOPSOIL, ALLUVIUM
15	to	72	BEDROCK, SHALE, HIGH CLAY FRACTION
	to		
	to		
	to		
	to		
	to		

INSTALLATION:

****

LYS/SCREEN/PERF TYPE : OPEN END (NO PERF.)
LYS PREPARATION :
MULTIPLE LYSIMETERS :
BOTTOM GROUT TYPE/DEPTH:
TOP GROUT TYPE/DEPTH :
PACK TYPE/DEPTH :
BOTTOM LYS/SCREEN :
TOP LYS/SCREEN :
BACKFILL TYPE/METHOD : CUTTINGS

INSTALLATION DIAGRAM



NOTES:

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3 gpm YIELD

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Waste Management
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LYSIMETER/WELL INSTALLATION REPORT

LOCATION: DSP-1
****
CLIENT : MDSL
JOB NAME : GOLDEY MAPLE
DATE DRILLED: ___/___/___
COUNTY : ____________
LEGAL : ____________
DATE INSTALLED: ___/___/___

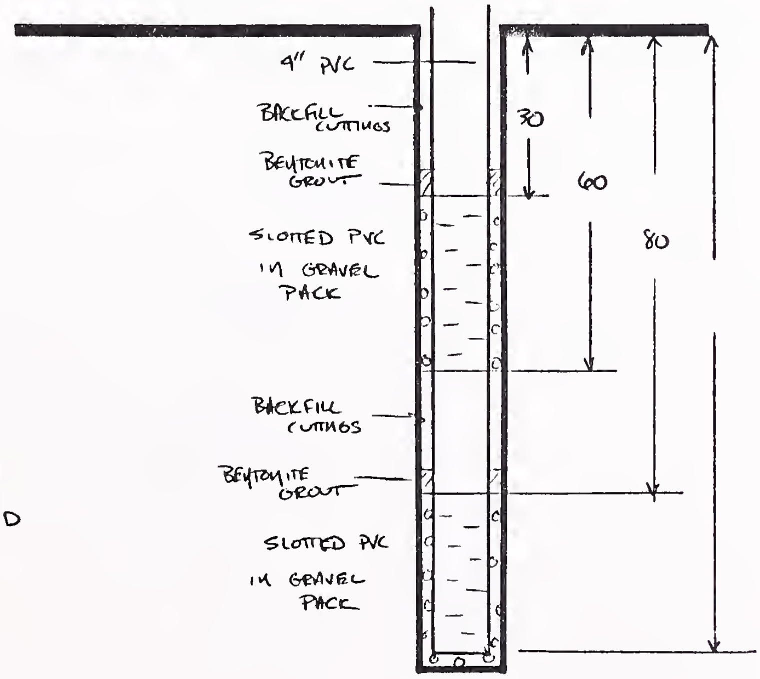
DRILLING:
****
METHOD : ____________
DRILLER : ____________
HOLE DEPTH : 105'
HOLE DIAMETER : 4" PVC CASING

DRILLING LOG

DEPTH INTERVAL			DESCRIPTION
0	to	60	ALLUVIUM
60	to	105	SHALE
	to		
	to		
	to		
	to		
	to		
	to		

INSTALLATION:
****
LYS/SCREEN/PERF TYPE : SLOTTED PVC
LYS PREPARATION : ____________
MULTIPLE LYSIMETERS : ____________
BOTTOM GROUT TYPE/DEPTH: ____________
TOP GROUT TYPE/DEPTH : ____________
PACK TYPE/DEPTH : ____________
BOTTOM LYS/SCREEN : ____________
TOP LYS/SCREEN : ____________
BACKFILL TYPE/METHOD : ____________

INSTALLATION DIAGRAM



TWO PERF INTERVALS AT 30-60' & 80-105'
- LOWER INTERVAL IS GRAVEL PACKED AND GROUTED AT 80' WITH BENTONITE
- BACKFILLED WITH CUTTINGS FROM 60'-80'
- UPPER PERF INTERVAL IS GRAVEL PACKED AND GROUTED AT 30' WITH BENTONITE.

NOTES:
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ABOUT 20 GPM YIELD

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LYSIMETER/WELL INSTALLATION REPORT

LOCATION: DSP-2

CLIENT :	MDSL	COUNTY :	
JOB NAME :	GOLDEN MAPLE	LEGAL :	
DATE DRILLED:	/ /	DATE INSTALLED:	/ /

DRILLING:

METHOD :		HOLE DEPTH :	60
DRILLER :		HOLE DIAMETER :	4" PVC CASING

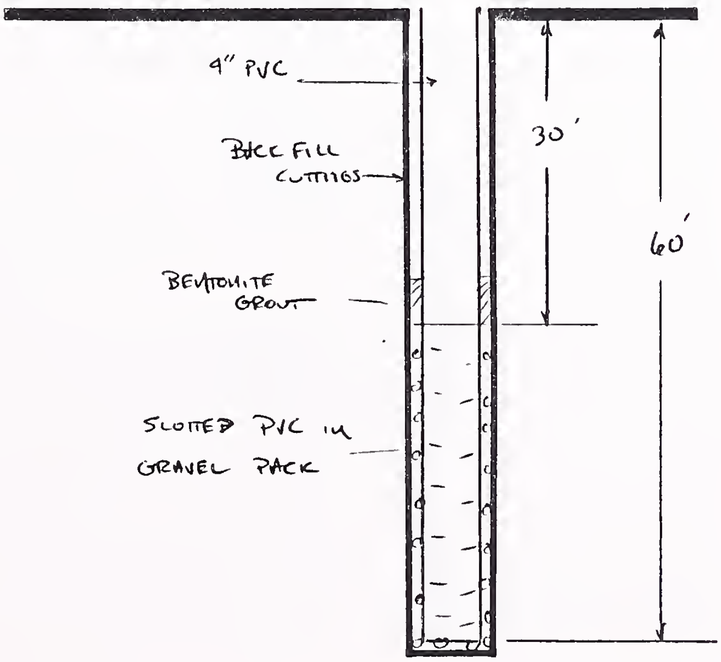
DRILLING LOG

DEPTH INTERVAL			DESCRIPTION
0	to	60	ALLUVIUM
	to		
	to		
	to		
	to		
	to		
	to		
	to		

INSTALLATION:

LYS/SCREEN/PERF TYPE :	SLOTTED PVC
LYS PREPARATION :	–
MULTIPLE LYSIMETERS :	
BOTTOM GROUT TYPE/DEPTH:	–
TOP GROUT TYPE/DEPTH :	BENTONITE, 30'
PACK TYPE/DEPTH :	GRAVEL
BOTTOM LYS/SCREEN :	60
TOP LYS/SCREEN :	30
BACKFILL TYPE/METHOD :	CUTTINGS

INSTALLATION DIAGRAM



NOTES:

ABOUT 20 GPM YIELD

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Waste Management
Land Reclamation
Resource Inventory
Agricultural Consulting

LYSIMETER/WELL INSTALLATION REPORT

LOCATION: DSP-3 Within 15' of Chippewa Cr.

****

CLIENT : MDSL
JOB NAME : Golden Maple
DATE DRILLED: ___/___/___
COUNTY :
LEGAL :
DATE INSTALLED: ___/___/___

DRILLING:

****

METHOD :
DRILLER :
HOLE DEPTH : 45'
HOLE DIAMETER : 4" PVC casing

DRILLING LOG

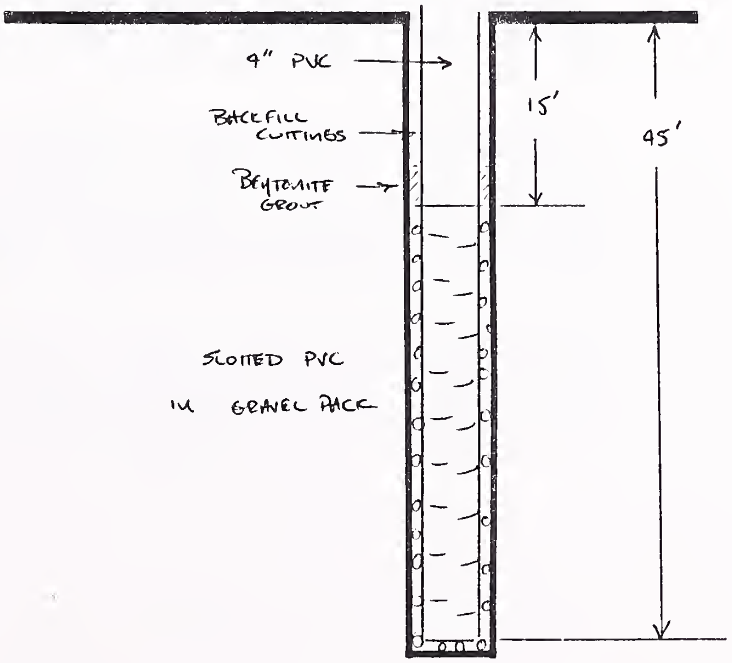
DEPTH INTERVAL			DESCRIPTION
0	to	20	Alluvium
20	to	45	Shale or tight silt
	to		~~Within 15'~~
	to		
	to		
	to		
	to		
	to		

INSTALLATION:

****

LYS/SCREEN/PERF TYPE : Slotted PVC
LYS PREPARATION :
MULTIPLE LYSIMETERS :
BOTTOM GROUT TYPE/DEPTH:
TOP GROUT TYPE/DEPTH : Bentonite, 15'
PACK TYPE/DEPTH : Gravel
BOTTOM LYS/SCREEN : 45
TOP LYS/SCREEN : 15
BACKFILL TYPE/METHOD : Cuttings

INSTALLATION DIAGRAM



NOTES:

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SOIL DESCRIPTIONS

GILTEDGE GOLD MINE
FERGUS COUNTY, MONTANA

Site #ST-3

Location: 650' North, 1,240' East of the SW corner Section 17, T16N, R20E
Elevation: 4900'
Classification: Fine-Loamy, Mixed, Typic Cryoboralfs
Native Vegetation: ponderosa pine, Douglas-fir, mixed forbs and grasses
Parent Material: alluvium/colluvium weathered from limestone and shale
Slope: 30%
Aspect: SSW
Relief: convex
Erosion: slight
Drainage: moderately well drained

A -- 0 to 8 inches, dark grayish-brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; granular structure; very hard (dry), very friable (moist), and slightly sticky and slightly plastic (wet); mildly alkaline (pH ~7.4); gradual, smooth boundary; common fine and medium roots; non-effervescent; 0% coarse fragments.

B -- 8 to 17 inches, brown (10YR 5/3) heavy loam, brown (10YR 4/3) moist; subangular blocky structure; very hard (dry), friable (moist), and sticky and slightly plastic (wet); mildly alkaline (pH ~7.4); gradual, wavy boundary; common very fine roots; slightly effervescent; common, medium, distinct mottles, 10YR 6/3 (dry), 10YR 6/8 (moist); < 5% coarse fragments.

BC-- 17 to 20 inches, dark yellowish-brown (10YR 4/4) heavy loam; subangular blocky structure; very hard (dry), friable (moist), and sticky and slightly plastic (wet); clear, smooth boundary; few fine roots; slightly effervescent; common, medium, distinct mottles, 10YR 6/8 (moist); < 5% coarse fragments.

C -- 20 to 40+ inches, yellowish-brown (10YR 5/4) loam; massive; very hard (dry), friable (moist), slightly sticky and non-plastic (wet); few fine roots; strongly effervescent; < 5% coarse fragments.

SOIL DESCRIPTIONS

GILTEDGE GOLD MINE
FERGUS COUNTY, MONTANA

Site #ST-4

Location: 1,100' North, 360' East of the SW corner Section 17, T16N, R20E
Elevation: 4950'
Classification: Fine-Loamy, Mixed (calcareous), Typic Cryoboralfs
Native Vegetation: ponderosa pine, Rocky Mountain juniper, woods rose
Parent Material: alluvium/colluvium over fractured limestone bedrock
Slope: 38%
Aspect: S
Relief: complex
Erosion: slight
Drainage: moderately well drained

Oi-- 3 to 1.5 inches, slightly decomposed needles.

Oa-- 1.5 to 0 inches, highly decomposed needles, leaves, and other forest litter.

A -- 0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish-brown (10YR 3/2) moist; granular structure; hard (dry), loose to very friable (moist), and non-sticky and non-plastic (wet); mildly alkaline (pH ~7.7); clear, smooth boundary; few fine and medium roots; slightly effervescent; 0% coarse fragments.

E -- 2 to 14 inches, light brownish-gray (10YR 6/2) loam, grayish-brown (10YR 5/2) moist; granular structure; hard (dry), very friable (moist), and slightly sticky and non-plastic (wet); mildly alkaline (pH ~7.8); clear, smooth boundary; few medium and coarse roots; violently effervescent; 0% coarse fragments.

EB-- 14 to 16 inches, yellowish-brown (10YR 5/4) loam; subangular blocky structure; hard (dry), friable (moist), and sticky and slightly plastic (wet); clear, wavy boundary; few coarse roots; violently effervescent; 0% coarse fragments.

Bt-- 16 to 20 inches, pale brown (10YR 6/3) clay loam, dark yellowish-brown (10YR 4/4) moist; angular blocky structure; very hard (dry), firm (moist), and sticky and plastic (wet); moderately alkaline (pH ~8.0); clear, smooth boundary; few coarse roots; violently effervescent; 5% coarse fragments.

C -- 20 to 31 inches, brown (10YR 5/3) clay loam; massive; very hard (dry), firm (moist), and sticky and plastic (wet); clear, smooth boundary; violently effervescent; 10% coarse fragments.

R -- 31+ inches, fractured limestone.

SOIL DESCRIPTIONS

GILTEDGE GOLD MINE
FERGUS COUNTY, MONTANA

Site #ST-5

Location: 125' North, 750' East of the SW corner Section 17, T16N, R20E
Elevation: 4950'
Classification: Loamy-Skeletal, Mixed (calcareous), Lithic Cryochrepts
Native Vegetation: open canopy ponderosa pine, Douglas-fir, moderate to thick ground cover of various shrubs, forbs, and grasses
Parent Material: solid and fractured limestone
Slope: 52%
Aspect: E
Relief: complex
Erosion: slight
Drainage: moderately well drained

Oi-- 0.5 to 0 inch, slightly decomposed needles.

A -- 0 to 1 inch, very dark grayish-brown (10YR 3/2) cobbly loam; granular structure; soft (dry), very friable (moist), and non-sticky and non-plastic (wet); abrupt, smooth boundary; many very fine, common fine and medium, and few coarse roots; slightly effervescent; 30% coarse fragments.

B -- 1 to 8 inches, brown (10YR 4/3) very cobbly loam, dark grayish-brown (10YR 4/2) moist; subangular blocky structure; slightly hard (dry), friable (moist), and slightly sticky and non-plastic (wet); mildly alkaline (pH ~7.6); clear, smooth boundary; many very fine, common fine and medium, and few coarse roots; slightly effervescent; 50% coarse fragments.

C -- 8 to 18 inches, yellowish-brown (10YR 5/4) extremely cobbly loam, brown (10YR 5/3) moist; subangular blocky structure; slightly hard (dry), friable (moist), and slightly sticky and non-plastic (wet); moderately alkaline (pH ~8.0); abrupt, wavy boundary; common very fine, fine, and medium roots; violently effervescent; 70% coarse fragments.

R -- 18+ inches, solid and fractured limestone.

SOIL DESCRIPTIONS

GILTEDGE GOLD MINE
FERGUS COUNTY, MONTANA

Site #ST-6

Location: 400' North, 50' West of the SE corner Section 18, T16N, R20E
Elevation: 5050'
Classification: Loamy-Skeletal, Mixed (calcareous), Typic Cryoboralfs
Native Vegetation: thick cover of juniper, Rocky Mountain maple, forbs, and grasses
Parent Material: coarse alluvium weathered from limestone
Slope: 65%
Aspect: NE
Relief: convex
Erosion: slight to uneroded
Drainage: well drained

Oe-- 1 to 0 inch, intermediately decomposed leaves from shrubs and forbs

A -- 0 to 4 inches, dark brown (10YR 3/3) gravelly loam, very dark grayish-brown (10YR 3/2) moist; granular structure; soft (dry), very friable (moist), and non-sticky and slightly plastic (wet); mildly alkaline (pH ~7.6); clear, smooth boundary; many very fine, common fine, and few medium roots; slightly effervescent; 20% coarse fragments.

B -- 4 to 16 inches, dark yellowish-brown (10YR 4/4) heavy very gravelly loam; angular blocky structure; soft (dry), friable (moist), and slightly sticky and slightly plastic (wet); mildly alkaline (pH ~7.8); clear, wavy boundary; many very fine, common fine and medium, and few coarse roots; strongly effervescent; 35% coarse fragments.

BC-- 16 to 20 inches, dark yellowish-brown (10YR 4/4) heavy very gravelly loam; subangular blocky structure; slightly hard (dry), friable (moist), and sticky and slightly plastic (wet); clear, wavy boundary; common very fine and fine, few coarse roots; strongly effervescent; 45% coarse fragments.

C1-- 20 to 33 inches, yellowish-brown (10YR 5/4) extremely gravelly clay loam; massive; hard (dry), firm (moist), and sticky and plastic (wet); abrupt, wavy boundary; common very fine and fine, and few medium roots; strongly effervescent; 65% coarse fragments.

C2-- 33 to 60+ inches, yellowish-brown (10YR 5/4) extremely gravelly clay loam; massive; hard (dry), firm (moist), and sticky and plastic (wet); common very fine and few fine roots; violently effervescent; 80% coarse fragments.